TOZZER LIBRARY
TZ 2725 R

Journal
of the
Washington Academy of
Sciences

Vol. 7 no. 2,6-8,10,14
Vol. 8 no. 6

H.D. L.SOC.
120.

Digitized by Google
Original from
HARVARD UNIVERSITY

H.D. L.Soc. 120.146.230.15

HARVARD UNIVERSITY

LIBRARY
OF THE
PEABODY MUSEUM OF AMERICAN
ARCHAEOLOGY AND ETHNOLOGY

Received

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google
Original from
HARVARD UNIVERSITY

Digitized by Google
Original from
HARVARD UNIVERSITY

Digitized by Google
Original from
HARVARD UNIVERSITY

Digitized by Google
Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google
Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

L. Soc. 120. 146. 230. 15

LIBRARY
PEABODY MUSEUM
RECEIVED
NOV 3 1955

Vol. VII

January 19, 1917

No. 2

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

BOARD OF EDITORS

William R. Maxon
NATIONAL MUSEUM

N. Ernest Dorsey
BUREAU OF STANDARDS

Adolph Knopf
GEOLOGICAL SURVEY

PUBLISHED SEMI-MONTHLY
EXCEPT IN JULY, AUGUST, AND SEPTEMBER, WHEN MONTHLY

BY THE

WASHINGTON ACADEMY OF SCIENCES

OFFICE OF PUBLICATION
WILLIAMS & WILKINS COMPANY
BALTIMORE, MD.

Entered as second-class matter July 14, at the post office at Baltimore, Maryland, under the Act of July 16, 1894

Digitized by Google

Original from
HARVARD UNIVERSITY

Journal of the Washington Academy of Sciences

This JOURNAL, the official organ of the Washington Academy of Sciences, aims to present a brief record of current scientific work in Washington. To this end it publishes: (1) short original papers, written or communicated by members of the Academy; (2) a complete list of references to current scientific articles published in or emanating from Washington; (3) short abstracts of certain of these articles; (4) proceedings and programs of meetings of the Academy and affiliated Societies; (5) notes of events connected with the scientific life of Washington. The JOURNAL is issued semi-monthly, on the fourth and nineteenth of each month, except during the summer when it appears on the nineteenth only. Volumes correspond to calendar years. Prompt publication is an essential feature; a manuscript reaching the editors on the second or the seventeenth of the month will ordinarily appear, on request from the author, in the next issue of the JOURNAL.

Manuscripts may be sent to any member of the Board of Editors; they should be clearly typewritten and in suitable form for printing without essential changes. The editors cannot undertake to do more than correct obvious minor errors. References should appear only as footnotes and should include year of publication.

Illustrations will be used only when necessary and will be confined to text figures or diagrams of simple character. The editors, at their discretion, may call upon an author to defray the cost of his illustrations, although no charge will be made for printing from a suitable cut supplied with the manuscript.

Proof.—In order to facilitate prompt publication no proof will be sent to authors unless requested. It is urged that manuscript be submitted in final form; the editors will exercise due care in seeing that copy is followed.

Authors' Copies and Reprints.—On request the author of an original article will receive gratis ten copies of the number containing his contribution and as many additional copies as he may desire at five cents each. Reprints will be furnished at the following schedule of prices:

	4 pp.	8 pp.	12 pp.	16 pp.
50 copies	$1.08	$1.95	$2.93	$3.80
100 copies	1.30	2.40	3.60	4.70
Additional copies, per 100	.45	.90	1.35	1.70

Covers bearing the name of the author and title of the article, with inclusive pagination and date of issue, will be $2.00 for the first 100. Additional covers $1.00 per 100.

As an author may not see proof, his request for extra copies or reprints should invariably be attached to the first page of his manuscript.

The rate of Subscription per volume is.................................. $6.00*
Semi-monthly numbers.................................. .25
Monthly numbers.................................. .50

Remittances should be made payable to "Washington Academy of Sciences," and addressed to the Treasurer, William Bowie, Coast and Geodetic Survey, Washington, D. C., to Williams & Wilkins Company, 2419–2421 Greenmount Ave., Baltimore, Md., or to the European Agents.

European Agents: William Wesley & Son, 28 Essex St., Strand, London, and Mayer and Müller, Prinz Louis-Ferdinand Str., Berlin.

Exchanges.—The JOURNAL does not exchange with other publications.

Missing Numbers will be replaced without charge, provided that claim is made within thirty days after date of the following issue.

* Volume I, however, from July 19, 1911 to December 19, 1911, will be sent for $3.00. Special rates are given to members of scientific societies affiliated with the Academy.

THE WAVERLY PRESS
BALTIMORE, U. S. A.

Digitized by Google
Original from
HARVARD UNIVERSITY

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

Vol. VII JANUARY 19, 1917 No. 2

MINERALOGY.—*Magnesioludwigite, a new mineral.*[1] B. S. Butler and W. T. Schaller, Geological Survey.

Introduction. In 1912, while making a reconnaissance examination of the Big and Little Cottonwood districts, Utah, one of the writers, B. S. Butler, collected specimens of the rather rare mineral ludwigite.[2] Specimens of this mineral from the Little Cottonwood district, in an undescribed collection made by J. M. Boutwell, were later examined.

During the summer of 1916 it was possible to make more detailed observations of the occurrence of the mineral, and chemical analysis has shown the presence of an allied mineral, hitherto undescribed, for which the name *magnesioludwigite* is proposed.

Locality. The largest body of ludwigite observed is at the Mountain Lake mine at the head of Big Cottonwood Canyon, about 1¼ miles south of Brighton. Ludwigite occurs in places to the southwest of the Mountain Lake mine for more than half a mile, nearly to Lake Catherine, and also to the east. It was collected on the south side of Little Cottonwood Canyon, southeast of the Michigan-Utah boarding house. It was observed

[1] Preliminary paper. Published with the permission of the Director of the U. S. Geological Survey.

[2] Butler, B. S., and Loughlin, G. F. *A reconnaissance of the Cottonwood-American Fork mining region, Utah.* U. S. Geol. Survey Bull. 620, p. 201. 1915.

Digitized by Google Original from HARVARD UNIVERSITY

in rock débris near the Alta-Brighton trail north of Twin Lakes, and is abundant in the South Columbus tunnel of the South Hecla mine. It will doubtless be found at other localities in the district. Magnesioludwigite was found only in the Mountain Lake mine.

Occurrence. Ludwigite occurs as a replacement of limestone at or near the contact with intrusive rocks and is associated with "contact minerals," including magnetite, forsterite, garnet, diopside, muscovite, and sulphides of iron and copper. In the Mountain Lake deposit magnetite and forsterite are the most abundant original minerals associated with the ludwigite. All of the minerals were probably formed at the same time, though the presence of veinlets of magnetite in the ludwigite and in the forsterite indicates that the magnetite continued to form after the ludwigite and forsterite had ceased to form. The sulphides also, in part at least, were formed probably later than the ludwigite and forsterite.

In the Mountain Lake deposit the ludwigite is in finely fibrous crystals, forming radial and spherulitic groups which make up large masses of the mineral. These, as seen with the unaided eye or the hand lens, resemble tourmaline. There are exposed in the outcrop and on the dump many tons of a mixture of magnetite and ludwigite. The ludwigite occurs also as isolated crystals and groups of crystals in metamorphosed limestone, and from such occurrences well-defined crystals with natural crystal faces have been isolated and measured. The ludwigite is dull greenish black (Ridgway's color scale). In the outcrop of the deposit there is also much material of ivy-green color (Ridgway's color scale), which is the mineral for which the name magnesioludwigite is proposed. Its occurrence is like that of the ludwigite.

Composition. Chemical analysis has shown that only 2.55 per cent of ferrous oxide is present in the ivy-green mineral, whereas typical ludwigite contains 17.01 per cent ferrous oxide. The analysis has also determined that the formula of the new mineral is $MgO.Fe_2O_3.3MgO.B_2O_3$, in which a small amount of ferrous oxide replaces some of the magnesia. The analysis

Digitized by Google

Original from HARVARD UNIVERSITY

can be interpreted as representing an isomorphous mixture of 85 per cent of magnesium borate with 15 per cent of ferrous borate. In its various properties magnesioludwigite shows the expected differences from those of the iron-richer ludwigite from Hungary. The luster is duller, the color lighter, the pleochroism and absorption weaker, and the translucency of the crushed material is markedly greater.

These various changes in properties are correlated with the changes in chemical composition, and the existence of a definite series from the ferrous-iron borate to the magnesium borate is well shown by specimens of the mineral from Hungary, Montana, and Utah. This correlation is being made and will be given in full in the detailed paper now in preparation.

The increased knowledge of the variation in chemical composition and corresponding variations in other properties makes it necessary to recognize the two end members of the series of the natural magnesium-iron borates. It is therefore proposed to use the name ludwigite as a group name, similarly to the usage of the terms mica and feldspar, and to introduce the two names magnesioludwigite and ferroludwigite for the end members and for those parts of the series in which the magnesium or the ferrous-iron borate, respectively, predominates.

Including the mineral pinakiolite in the group, the ludwigite group comprises then the following minerals, the term ludwigite being usable for any member of the group until its exact relation has been determined:

Group
    Ludwigite
        Species
            Ferroludwigite, $FeO.Fe_2O_3.3MgO.B_2O_3$
            Magnesioludwigite, $MgO.Fe_2O_3.3MgO.B_2O_3$
            Pinakiolite, $MnO.Mn_2O_3.3MgO.B_2O_3$.

ANTHROPOLOGY.—*Significance of the terms for brother and sister among primitive peoples.* JOHN R. SWANTON, Bureau of American Ethnology.

It is well known that among tribes divided into clans or gentes the terms for those relations for which we use "brother"

Digitized by Google Original from HARVARD UNIVERSITY

and "sister" are extended to a large number of individuals of the same clan or gens and of approximately the same age as the speaker, but even experienced investigators are not so vividly conscious of the fact that they are by no means confined to that clan or gens. The idea of such a limitation is largely due to the fact that very many tribes, such for instance as the Iroquois, Choctaw, Chickasaw, Tlingit, Haida, and several of the Plains tribes, have only two exogamous groups, and that in such groups the men called collectively "fathers" are the husbands of the women called collectively "mothers." It happens, therefore, that the children of the father's brothers and the mother's sisters are the very same set of individuals and must always be of the exogamous division of the speaker and his own brothers and sisters. Thus it might be thought that the terms brother and sister were applied because the individuals so called were of the same clan or gens as self.

In order to discover the true reason for the application of these terms we must turn to tribes having three or more exogamous groups. Among peoples of this kind with matrilineal descent the men of the father's clan will be able to marry into two or more others and their children will be of the same number of clans, while if the descent is patrilineal the women of the mother's clan will have the same variety of choice. Now, if the terms for brother and sister are primarily clan or gentile terms, they will not be applied to children of the father's clan or the mother's gens *not of the clan or gens of the speaker*. If they are primarily consanguineal terms they will be so applied.

In the present article I shall not attempt an exhaustive study of this question but confine myself to an examination of the lists given by Morgan in his *Systems of Consanguinity and Affinity*[1] and those recorded by Rivers in *The History of Melanesian Society*. The internal diversity of the two regions, each of which presents examples of tribes with exogamous divisions and tribes without, tribes with matrilineal descent and tribes with patrilineal descent, tribes with dual divisions and tribes with multiple divisions, along with their remoteness from

[1] Smithsonian Contributions to Knowledge, vol. 17.

Digitized by Google

Original from
HARVARD UNIVERSITY

each other, and the difference in time and circumstance under which they were recorded, promises a very fair sample of what may be looked for in primitive society as a whole.

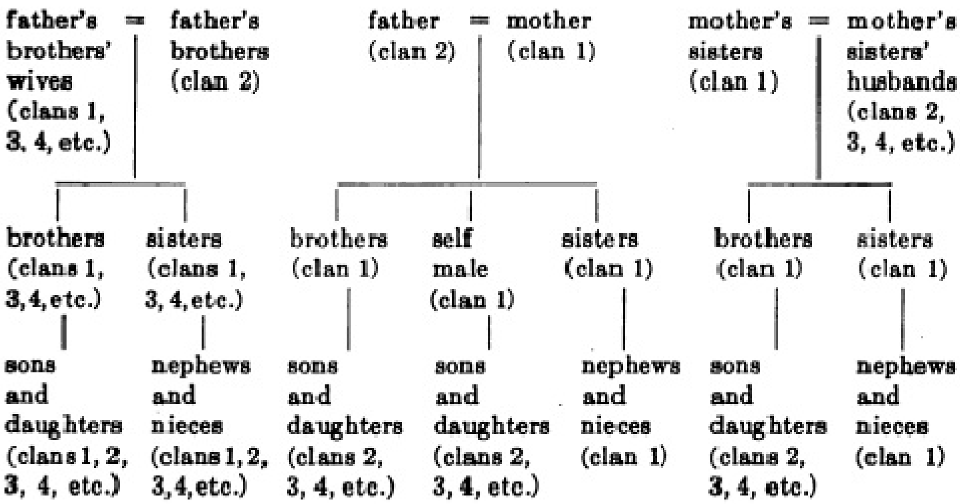
An inspection of the lists given by Morgan shows that the terms for brother and sister—elder and younger being also frequently distinguished—are employed by all tribes from which information is supplied except the Eskimo, who are without exogamous groups and therefore do not concern us. It is true that among certain peoples, such as the Chippewa, Ottawa, Potawatomi, Mohegan, Delaware, Spokane, and Creek, a distinction is introduced between the own brother and sister and collateral brothers and sisters, who are often called "step-brothers," "step-sisters," "other brothers," and so on; but we find that in most cases these exceptional terms apply to both the child of the father's brother and the child of the mother's sister; therefore their significance is mainly consanguineal and their use strengthens rather than weakens the argument for consanguinity. In one or two other cases the terms used are alternatives. Rivers yields precisely the same testimony. In his explanation of the terms employed in the island of Florida he specifically states that those for brother and sister were used "in the usual classificatory sense for all members of the clan of the same generation" and that they were applied also "in the same way to the children of the father's brothers, although these may be of different clans." By implication the same must be assumed in the systems recorded by him from the Torres Islands, Santa Cruz, the Reef Islands, Guadalcanar, Ysabel, and Savo, all of those in which there are more than two exogamous divisions and from which information is vouchsafed. The same is found, as we should expect, in tribes having two exogamous groups, and also in tribes without exogamous groups. In some cases these terms are so widely extended as to apply to the cross-cousins as well, the children of the father's sister and the mother's brother. The outstanding fact is, however, that the application of the terms for brother and sister is evidently governed by the relation of the parents of the persons so called to self.

Digitized by Google	Original from HARVARD UNIVERSITY

Precisely the same thing appears in the succeeding generation, where the use of the terms son and daughter, and nephew and niece, is plainly determined by the status of the parents of those so denominated.

These facts may be illustrated by the accompanying diagram, in which it is to be understood that each English expression stands for a single native term. It supposes a tribe with several clans and matrilineal descent, self male. Other systems would involve a few simple and readily comprehended changes.

DIAGRAM ILLUSTRATING "BROTHER" AND "SISTER" RELATIONSHIPS.



An examination of the remaining terms of relationship shows that almost the only ones which have a strictly clan or gentile connotation are those for father, mother, father's sister, and mother's brother. Those who argue for the priority of exogamous divisions to relationship terminology and for their clan rather than consanguineal significance are therefore reduced to the assumption that such divisions first determined the four terms last given and that all of the others were developed from them on purely consanguineal lines. But even in the case of these four terms we ordinarily find a distinction between the own father and mother and the clan or gentile father and mother, and frequently there are other exceptions to a strictly

Digitized by Google
Original from
HARVARD UNIVERSITY

clan usage of the terms. A theory which has to admit so many exceptions and which must grant the dominance of consanguineal considerations in all but a few cases may well be viewed with suspicion. It is certainly a clumsy device when compared with the alternative theory of a simple extension of terms founded on the idea of blood relationship to groups of persons hypothetically, though not actually, related.

Digitized by Google Original from HARVARD UNIVERSITY

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

PHYSICS.—*A study of electromagnet moving coil galvanometers for use in alternating current measurements.* ERNEST WEIBEL. Bureau of Standards Scientific Paper No. 297 (Bull. Bur. Stds., **14**: 23-58). 1917.

This paper gives the results of a study of the electromagnet moving coil galvanometer that has led to the construction of instruments with sensitivities much greater than those previously obtained and equal to those of the best direct current moving coil galvanometers. The theory of the instrument is developed. The equation of motion is first expressed in terms of the intrinsic constants (the moment of inertia, the moment of damping, the moment of restoration, and the moment of displacement) and the deflection, velocity, acceleration, and current in the moving coil. The current is then known from the resultant electromotive force in the moving coil circuit and the latter's constants. It is necessary in computing the resultant electromotive force to consider not only the impressed but also the induced electromotive force. The latter is in part due to the motion of the coil in the magnetic field, causing electromagnetic damping, and in part due to the alternation of the flux linking with the coil, causing a current which results in a control torque in addition to that of the suspensions. The paper also contains descriptions and gives the performances of four instruments. The results indicate that the theory as given is fundamentally correct and therefore serves as a good basis for the design and use of instruments of this kind. E. W.

GEOLOGY.—*The lignite field of northwestern South Dakota.* DEAN E. WINCHESTER, C. J. HARES, E. RUSSELL LLOYD, and E. M. PARKS. U.S. Geological Survey Bulletin 627. Pp. 165, with 11 plates. 1916.

The report describes the geology and fuel resources of parts of Perkins and Harding counties in northwestern South Dakota. The

Digitized by Google Original from HARVARD UNIVERSITY

formations in the area include the Pierre, Fox Hills, Lance, Fort Union, White River, and Arikaree. The Lance is subdivided into three members: a lower undifferentiated portion, 425 feet thick; a middle or Ludlow lignite-bearing portion, 350 feet thick at most; and an upper marine member, the Cannonball, 225 feet thick.

The marine fauna of the Cannonball member is very similar to but not identical with the fauna of the Fox Hills, which is of recognized Cretaceous age, while the flora of the Ludlow lignitic member is so much like that of the Fort Union, which is of recognized Tertiary age, that it is impossible to differentiate it from the Fort Union on the basis of the fossil leaves.

Lignite beds are found in both the Lance and Fort Union formations, the more important beds occurring in the Lance formation.

D. E. W.

GEOLOGY.—*Reconnaissance of the Conconully and Ruby mining districts, Washington.* E. L. Jones, Jr. U. S. Geological Survey Bulletin 640-B. Pp. i–iv, 11–36, with 1 plate. 1916.

This report describes the geology and ore deposits of a small area in the central part of Okanogan County, Washington. In general the rocks comprise an older series of metamorphic rocks and a younger series of igneous rocks of batholithic origin. The metamorphic rocks consist of schists, quartzites, and limestones. Some of the schists are fine-grained and thinly laminated, but others are coarsely banded micaceous rocks that are evidently altered sandstones. The most schistose and gneissoid rocks are those which border the batholith. Closely associated with this sedimentary series are dike rocks and lavas that have undergone the same metamorphism and are probably of the same age, which is supposed to be Carboniferous.

The common igneous rock of the area is a gray granite which has intruded the sedimentary rocks. It occurs over a large area and is probably a part of the Similkameen batholith. There are other igneous rocks of considerable areal extent, including a dark granite and an altered green porphyry. Dikes are abundant, particularly along the contact of the batholith with the metamorphic rocks; they include granite, diorite, pegmatite, and aplite, and probably represent the closing stage of igneous activity.

The ore deposits are principally of two types, quartz veins and disseminated or replacement deposits. The quartz veins are widely distributed throughout the area, but those of proved value are grouped

Digitized by Google Original from HARVARD UNIVERSITY

along the contact of the granite with the schists and gneisses. They are valuable for their lead-silver content and have yielded the principal output. The replacement deposits occur principally in a small area at the northern end of the Conconully district. They contain small amounts of copper and gold, but no ore has yet been produced commercially from them. R. W. S.

GEOLOGY.—*A reconnaissance of the Archean complex of the Granite Gorge, Grand Canyon, Arizona.* L. F. Noble and J. Fred. Hunter. U. S. Geological Survey Professional Paper No. 98-I. Pp. 95–102, with 1 plate and 2 figures. 1916.

The Tonto platform on the south side of the Granite Gorge affords a magnificent but difficultly accessible cross-section through the Archean complex, 800 feet deep and 40 miles in length. These oldest rocks of the Grand Canyon were visited in twenty localities, 67 hand specimens were collected, and eight distinct groups of rocks were recognized. The exposures within these groups are described and the petrography of the specimens is given.

Estimated roughly, the gneisses (granite gneiss, hornblende gneiss, and metabasite) comprise 50 per cent of the rock exposed in the Granite Gorge; the mica schist, 30 per cent; the basic intrusives, 10 per cent; and the pink siliceous intrusives, 10 per cent. It is not improbable that the mica schists are in large part of sedimentary origin. It is believed that some of the wrinkled and contorted granite gneisses represent the original basement on which the schist series of metamorphosed sediments was laid down; that both before and after the deposition of the sediments there were long periods of complex intrusion, represented by amphibolites, granitic gneiss, metabasite, and metadiorite; that during and after the metamorphism of the schists and gneisses there were further intrusions of quartz diorite, gabbro, granite, pegmatite, and other rocks. It will probably be advisable, at some future time, to restrict the name "Vishnu schists," now used for the entire Archean complex, to the mica-schist series and give another name or names to the gneisses. J. F. H.

GEOLOGY.—*An anticlinal fold near Billings, Noble County, Oklahoma.* A. E. Fath. U. S. Geological Survey Bulletin 641-E. Pp. 121–138, with 1 plate. 1916.

During February, 1916, gas was struck in small quantities at shallow depths in a well being drilled a few miles southwest of Billings, Noble

Digitized by Google Original from HARVARD UNIVERSITY

County, Oklahoma. As this discovery was made at a place more than 20 miles distant from any other known oil and gas development, it has attracted considerable attention, which is justified by the presence of a large anticlinal fold, a type of structure that should be favorable for the accumulation of oil and gas. A description of the anticlinal fold and a discussion of the possibilities of developing an oil and gas field here are given. R. W. S.

PALEONTOLOGY.—*North American Upper Cretaceous corals of the genus Micrabacia.* LLOYD WILLIAM STEPHENSON. U. S. Geological Survey Professional Paper 98-J. Pp. 115–131, with 4 plates. 1916.

The report describes seven species and two varieties of corals of the genus *Micrabacia* from the United States, all but one of which, *M. americana* Meek and Hayden, are new. All are from the Atlantic and Gulf coastal plains, except *M. americana* and its variety *multicostata* from the Montana group of the Western Interior. Of the coastal-plain species, *M. cribraria* is from the upper part of the *Exogyra ponderosa* zone (North Carolina—Alabama), and the remainder are from the *Exogyra costata* zone of Maryland, Georgia, Mississippi, and Texas. The American species are compared with the type species of the genus, *M. coronula* Goldfuss, a description and figures of which are included, from Essen, Prussia. Each of the species has a small disc-shaped corallum, the largest, *M. rotatilis*, being only 9 mm. in diameter; in order to illustrate the characters it is necessary to magnify them four to eight times. L. W. S.

TECHNOLOGY.—*The recovery of paraffin and paper stock from waste paraffin paper.* W. H. SMITH. Bureau of Standards Technologic Paper No. 87. Pp. 4. 1916.

This paper describes a process for the recovery of the paraffin and paper stock from waste paraffin paper. The waste is pulped with exhaust steam in a vertical boiler. The wax rises to the surface and is drawn off with the hot water through a screen, the stock settling to the bottom of the boiler. The stock is transferred to a beating engine and further treated for the removal of the residual paraffin. Paper prepared from the recovered stock was free from wax and satisfactory in every respect. Practically all of the paper stock is recovered, but about ten per cent of the paraffin in the waste is lost during the process. W. H. S.

Digitized by Google Original from HARVARD UNIVERSITY

REFERENCES

Under this heading it is proposed to include, by author, title, and citation, references to all scientific papers published in or emanating from Washington. It is requested that authors cooperate with the editors by submitting titles promptly, following the style used below. These references are not intended to replace the more extended abstracts published elsewhere in this JOURNAL.

CHEMISTRY

BLUM, WILLIAM. *The determination of aluminium as oxide.* Bureau of Standards Scientific Paper No. 286 (Bull. Bur. Stds., **13**: 515–534). 1916.

CAIN, J. R., SCHRAMM, E., and CLEAVES, H. E. *The preparation of pure iron and iron-carbon alloys.* Bureau of Standards Scientific Paper No. 266 (Bull. Bur. Stds., **13**: 1–26). 1916.

CLARKE, F. W., and WHEELER, W. C. *The inorganic constituents of alcyonaria.* Proc. National Acad. Sci., **1**: 552–556. 1915.

GILLESPIE, L. J. *The reaction of soil and the measurements of hydrogen-ion concentration.* Journ. Wash. Acad. Sci., **6**: 7–16. 1916.

HILLEBRAND, W. F., and SCHERRER, J. A. *Recovery of gallium from spelter in the United States.* Journ. Ind. and Eng. Chem., **8**: 225. 1916.

LUBS, HERBERT A., and CLARK, MANSFIELD. *On some new indicators for the colorimetric determination of hydrogen-ion concentration.* Journ. Wash. Acad. Sci., **5**: 609–617. 1915.

WATERS, C. E., and TUTTLE, J. B. *Some qualitative tests for gum arabic and its quantitative determination.* Bureau of Standards Technologic Paper No. 67. Pp. 15. 1916.

WEAVER, E. R. *The colorimetric determination of acetylene and its application to the determination of water.* Bureau of Standards Scientific Paper No. 267 (Bull. Bur. Stds., **13**: 27–65). 1916.

MAMMALOGY

ALLEN, J. A. *The genotypes of Echimys and Loncheres.* Proceedings of the Biological Society of Washington, **29**: 205–206. September 22, 1916. (Argues that *E. spinosus* is the type of Echimys and *L. chrysurus* the type of Loncheres.—N. H.)

GABRIELSON, I. N. *A second record of* Nyctinomus depressus *for Iowa.* Proceedings of the Biological Society of Washington, **29**: 86. April 4, 1916. (A specimen of this southwestern species taken at Marshalltown.—N. H.)

GOLDMAN, E. A. *Notes on the genera* Isothrix *Wagner and* Phyllomys *Lund.* Proceedings of the Biological Society of Washington, **29**: 125–126. June 6, 1916. (Several species heretofore included in Isothrix are transferred to the genus Phyllomys.—N. H.)

GOLDMAN, E. A. *The status of* Sigmodontomys alfari *Allen and* Oryzomys ochraceus *Allen.* Proceedings of the Biological Society of Washington, **29**: 127. June 6, 1916. (These specific names are synonymous, and the animal should be called *Nectomys alfari*.—N. H.)

Digitized by Google Original from HARVARD UNIVERSITY

GOLDMAN, E. A. *A new vesper rat from Nicaragua.* Proceedings of the Biological Society of Washington, **29**: 155–156. September 6, 1916. (Describes *Nyctomys sumichrasti venustulus* from Greytown.—N. H.)

GRINNELL, J. *The California lowland mink a distinct race.* Proceedings of the Biological Society of Washington, **29**: 213–214. September 22, 1916. (Describes *Mustela vison aestuarina* from Solano County.—N. H.)

HOLLISTER, N. *Descriptions of a new genus and eight new species and subspecies of African mammals.* Smithsonian Miscellaneous Collections, **66**[1]: 1–8. February 10, 1916. (Cercoctenus, new genus of Macroscelidae; and new forms in the genera Surdisorex, Rhinolophus, Eptesicus, Chaerephon, Genetta, Mungos, and Helogale.—N. H.)

HOLLISTER, N. *Three new African shrews of the genus Crocidura.* Smithsonian Miscellaneous Collections, **66**[3]: 1–3. May, 1916. (*C. daphnia* described from Uganda; *C. parvipes nisa* and *C. simiolus* described from British East Africa.—N. H.)

HOLLISTER, N. *The generic names Epimys and Rattus.* Proceedings of the Biological Society of Washington, **29**: 126. June 6, 1916. (Rattus the proper generic name for the Norway rat and its allies.—N. H.)

HOLLISTER, N. *A systematic account of the prairie-dogs.* North American Fauna No. 40. Pp. 1–37, pls. 1–7. June 20, 1916. (New subgenus, Leucocrossuromys, for the white-tailed prairie-dogs; new subspecies *Cynomys gunnisoni zuniensis,* from New Mexico.—N. H.)

HOLLISTER, N. *The type species of Rattus.* Proceedings of the Biological Society of Washington, **29**: 206–207. September 22, 1916. (*Mus norvegicus* is the type of *Rattus* Fischer, 1803.—N. H.)

HOLLISTER, N. *Shrews collected by the Congo expedition of the American Museum.* Bulletin of the American Museum of Natural History, **35**: 663–680, pls. 7–11. October 21, 1916. (Six new species of Crocidura and one of Sylvisorex from Belgian Congo.—N. H.)

HOLLISTER, N. *Three new murine rodents from Africa.* Smithsonian Miscellaneous Collections, **66**[10]: 1–3. October 26, 1916. (Describes new forms of Arvicanthis, Dasymys, and Mus.—N. H.)

HOWELL, A. H. *Description of a new pine mouse from Florida.* Proceedings of the Biological Society of Washington, **29**: 83–84. April 4, 1916. (*Pitymys parvulus,* sp. nov., from Ocala.—N. H.)

JACKSON, H. H. T. *A new bat from Porto Rico.* Proceedings of the Biological Society of Washington, **29**: 37–38. February 24, 1916. (Describes *Eptesicus wetmorei* from Maricao.—N. H.)

LANTZ, D. E. *Cottontail rabbits in relation to trees and farm crops.* U. S. Department of Agriculture Farmers' Bulletin No. 702. Pp. 1–12, figs. 1–5. January 17, 1916. (Discusses the habits of cottontail rabbits and methods of controlling their numbers.—N. H.)

LANTZ, D. E. *Laws relating to fur-bearing animals, 1916.* United States Department of Agriculture Farmers' Bulletin No. 783. Pp. 1–28. October 19, 1916. (A summary of laws in the United States and Canada relating to fur-bearing animals.—N. H.)

Digitized by Google Original from HARVARD UNIVERSITY

Lyon, M. W., Jr. *A porcupine skull with a pair of supernumerary well developed incisors in the upper jaw.* Anatomical Record, **10**: 459–462. April 20, 1916. (Note on abnormal dentition of *Acanthion longicaudum*.—N. H.)

Lyon, M. W., Jr. *Belgian hare, a misleading misnomer.* Science, N. S., **43**: 686. May 12, 1916. (Corrects error in generic identification of the Belgian "hare" in anatomical paper by C. D. Holliger.—N. H.)

Lyon, M. W., Jr. *Two new mammals from Sumatra.* Proceedings of the Biological Society of Washington, **29**: 209–211. September 22, 1916. (Describes new forms of Rattus.—N. H.)

Merriam, C. H. *East Africa—Game garden of the world.* American Museum Journal, **16**: 145–153. March, 1916. (A review of Roosevelt and Heller's "Life-Histories of African Game Animals," 1914.—N. H.)

Merriam, C. H. Ovis sheldoni, *a new mountain sheep from Sierra del Rosario, Sonora, Mexico.* Proceedings of the Biological Society of Washington, **29**: 129–132. September 6, 1916.

Merriam, C. H. *Nineteen apparently new grizzly and brown bears from western America.* Proceedings of the Biological Society of Washington, **29**: 133–154. September 6, 1916. (Descriptions of new species and subspecies of Ursus, with remarks on distribution and relationship of mainland and island forms.—N. H.)

Miller, G. S., Jr. *Note on the indigenous rodent of Santo Domingo.* Proceedings of the Biological Society of Washington, **29**: 47. February 24, 1916. (Records additional specimens of *Plagiodontia aedium* Cuvier, hitherto known only by the type described in 1836.—N. H.)

Miller, G. S., Jr. *Remains of two species of Capromys from ancient burial sites in Jamaica.* Proceedings of the Biological Society of Washington, **29**: 48. February 24, 1916. (A species apparently much like the form known from Little Swan Island is represented by bones; as well as remains of the previously known Jamaica species, *C. brownii*.—N. H.)

Nelson, E. W. *The larger North American mammals.* National Geographic Magazine, **30**: 385–472. November, 1916. (A popular account, illustrated by numerous colored pictures by L. A. Fuertes.—N. H.)

Taylor, W. P. Aplodontia humboldtiana, *a new mountain beaver from the Humboldt Bay district, California.* Proceedings of the Biological Society of Washington, **29**: 21–23. February 24, 1916.

Thomas, O. *Note on the name* Corynorhinus megalotis. Proceedings of the Biological Society of Washington, **29**: 127. June 6, 1916. (Preoccupied; replaced by *Corynorhinus rafinesquii*.—N. H.)

TECHNOLOGY

Ahlborn, G. H. *Data on electric railway track leakage.* Bureau of Standards Technologic Paper No. 75. Pp. 22. 1916.

Boughton, E. W. *The determination of volatile thinner in oil varnish.* Bureau of Standards Technologic Paper No. 76. Pp. 6. 1916.

Briggs, C. A. *Relative merits of long and short wheel-base test cars.* The Scale Journ., **1**: 5. 1915; Railway Rev., Aug. 14, 1915; Railway Age Gaz., April 21, 1916.

Briggs, C. A. *Automatic grain scales.* Scale Journ.. Jan. and May, 1916.

Digitized by Google Original from HARVARD UNIVERSITY

Briggs, C. A. *Graphical study of railroad track scales and master scale performances.* Scale Journ., June. 1916; Railway Rev., July 15, 1916.

Bureau of Standards. *Analyzed irons and steels. Methods of analysis.* Bureau of Standards Circular No. 14, 5th ed. Pp. 17. 1916.

Bureau of Standards. *Magnetic testing.* Bureau of Standards Circular No. 17, 3d ed. Pp. 50. 1916.

Bureau of Standards. *Measurements for the household.* Bureau of Standards Circular No. 55. Pp. 149. 1915.

Burgess, G. K., and Merica, P. D. *Some foreign specifications for railway materials: Rails, wheels, axles, tires.* Bureau of Standards Technologic Paper No. 61. Pp. 132. 1916.

Cain, J. R., and Cleaves, H. E. *Determination of carbon in steels and irons by direct combustion in oxygen at high temperatures.* Bureau of Standards Technologic Paper No. 69. Pp. 10. 1916.

Karr, C. P., and Rawdon, Henry S. *Standard test specimens of zinc bronze (Cu 88, Sn 10, Zn 2). Part I.—Preparation of specifications; Part II.—Microstructure.* Bureau of Standards Technologic Paper No. 59. Pp. 67. 1916.

Lewis, Walter S. *Difference in weight between raw and clean wools.* Bureau of Standards Technologic Paper No. 57. Pp. 5. 1915.

McCullom, B., and Ahlborn, G. H. *Special studies in electrolysis mitigation. III. A report on conditions in Springfield, Ohio, with insulated feeder system installed.* Bureau of Standards Technologic Paper No. 54. Pp. 64. 1916.

McCullom, B., and Logan, K. H. *Special studies in electrolysis mitigation. IV. A preliminary report on electrolysis mitigation in Elyria, Ohio, with recommendations for mitigation.* Bureau of Standards Technologic Paper No. 55. Pp. 49. 1916.

McCullom, B., and Ahlborn, G. H. *Influence of frequency of alternating or infrequently reversed currents on electrolytic corrosion.* Bureau of Standards Technologic Paper No. 72. Pp. 31. 1916.

Rosa, E. B., Brooks, H. B., McCullom, B., Canada, W. J., and Glading, F. W. *An investigation of enclosed cartridge fuses. Report of the Bureau of Standards in the case of Economy Fuse and Manufacturing Co. vs. Underwriters' Laboratories (Inc.), concerning the fire and accident hazard of the Economy Refillable Fuse as compared with approved fuses.* Bureau of Standards Technologic Paper No. 74. Pp. 199. 1916.

Tuttle, J. B. *Determination of barium carbonate and barium sulphate in vulcanized goods.* Bureau of Standards Technologic Paper No. 64. Pp. 5. 1916; Journ. Ind. and Eng. Chem., **8**: 324. 1916; Chem. Eng., **23**: 129. 1916; Chem. Abs., **10**: 1289. 1916.

Waters, C. E., and Tuttle, J. B. *Some qualitative tests for gum arabic and its quantitative determination.* Bureau of Standards Technologic Paper No. 67. Pp. 15. 1916; Journ. Ind. and Eng. Chem., **8**: 413–416. 1916.

Waters, C. E. *Data on the oxidation of automobile cylinder oils.* Bureau of Standards Technologic Paper No. 73. Pp. 20. 1916; Journ. Ind. and Eng. Chem., **8**: 587–592. 1916.

Wig, R. J., Williams, G. M., and Gates, E. R. *Strength and other properties of concretes as affected by materials and methods of preparation.* Bureau of Standards Technologic Paper No. 58. Pp. 172. 1916.

Digitized by Google Original from HARVARD UNIVERSITY

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE BOTANICAL SOCIETY OF WASHINGTON

The sixteenth annual meeting of the Botanical Society of Washington was held in Room 32 of the Bureau of Plant Industry building, U. S. Department of Agriculture, at 1.30 p.m., October 16, 1916, with W. E. SAFFORD acting chairman and H. L. SHANTZ acting secretary.

The minutes of the fifteenth annual meeting were read and approved and the report of the Executive Committee read and approved. The report of the Treasurer was read and an Auditing Committee, consisting of P. L. RICKER and G. P. VAN ESELTINE, appointed by the Chair.

The following officers were elected for the ensuing year: *President,* T. H. KEARNEY; *Vice-President,* EDGAR L. BROWN; *Recording Secretary,* CHARLES E. CHAMBLISS; *Corresponding Secretary,* H. L. SHANTZ; *Treasurer,* F. D. FARRELL.

Mr. A. S. HITCHCOCK was nominated by the society as Vice-President of the Washington Academy of Sciences.

The 115th regular meeting of the Society was held at the Cosmos Club Tuesday, November 7, 1916, at 8.00 p.m.

Mr. MICHAEL SHAPOVALOV, Dr. HOWARD G. MACMILLAN, Dr. JOSEPH ROSENBAUM, and Mr. F. E. MILLER were elected to membership in the Society.

Under Brief Notes and Reviews of Literature, Mr. W. T. SWINGLE called attention to a recent edition of an ancient Chinese work on botany, *The Cheng lei pen ts'ao,* originally published in 1108 A.D. Dr. A. T. TENAKA reviewed briefly a recently issued *Hand Book of Plant Diseases of Japan,* by Jinzo Matsumura.

The following papers were presented:

Notes on the life of John Bradbury: R. H. TRUE. Information concerning the life of this early naturalist and explorer of the Missouri Valley is very meager. A considerable addition has been gained from the correspondence carried on between Bradbury and Thomas Jefferson, who greatly influenced the course of Bradbury's life and work in this country. Bradbury's life, as gathered from this and other available sources, was sketched in outline.

Digitized by Google
Original from
HARVARD UNIVERSITY

Pathological problems in the distribution of perishable plant products: C. L. Shear and W. A. Orton. The enormous losses in recent years caused by the deterioration and decay of fruits and vegetables between the field and the consumer have led to a more active interest in this subject and a desire on the part of those most directly affected to have the causes and means of prevention determined. In most cases fungi are the active agents in causing the destruction of such products, and the problem is primarily pathological. In order to devise means of avoiding these losses, a thorough knowledge of all the factors and conditions involved must be obtained. Each fruit and vegetable has its own peculiarities and its own parasites. In some cases the cause of loss may be traced to the field, and in others to conditions of transportation and handling. In any specific case the cause and responsibility for the loss can be determined only by careful investigation of all the facts. Specific cases of losses of strawberries, peaches, cranberries, watermelons, tomatoes, and potatoes were cited to indicate the complexity of the problems and the danger of drawing any general conclusions from insufficient data. It was shown that the means of preventing such losses will depend upon the nature of the cause or causes, as determined by a knowledge of all the factors in any particular case.

H. L. Shantz, *Corresponding Secretary.*

BIOLOGICAL SOCIETY OF WASHINGTON

The 561st meeting of the Society was held at the Cosmos Club, Saturday, December 2, 1916; called to order by President Hay at 8 p.m. with 50 persons in attendance.

The following program was presented:

W. P. Hay: *The discovery of an interesting new tardigrade.*

Professor Hay gave a brief description of a tardigrade belonging to the genus *Batillipes*, discovered by him some years ago at Beaufort, N. C. It is closely related to *B. mirus* Richters but differs from that species in a number of important characters. The structure and relationship of the tardigrades were discussed and the conclusion was reached that *Batillipes*, in spite of its evident specialization along certain lines, is probably the most primitive genus of the group. From *Batillipes* through *Halechiniscus* to *Oreella* and *Echiniscus* was suggested as one line of development, while from *Echiniscoides* through *Milnesium* to *Macrobiotus* and *Diphascon* appears to be another. The genus *Tetrakentron*, with its single species *T. synaptae*, shows a high degree of specialization due to parasitism, and *Microlyda* is probably the larval form of *Halechiniscus*.

Attention was called to the habitat of the ten animalcules belonging to these genera. Five of them, *Batillipes*, *Halechiniscus*, *Microlyda*, *Tetrakentron*, and *Echiniscoides* are marine; *Echiniscus* and *Oreella* are strictly terrestrial; *Macrobiotus* is mostly terrestrial or lacustrine, but is represented in salt water by at least two species; *Diphascon* is

Digitized by Google Original from HARVARD UNIVERSITY

terrestrial and lacustrine. The fact that the majority of the genera are marine and that this list includes all the more primitive genera points strongly to a marine origin for the group. It also supports the idea advanced by Professor Richters in 1909 that the tardigrades are probably most closely related to the chaetopod worms and should be removed from the class Arachnida in or near which the group is usually placed in our zoological text books. Professor Hay's communication was illustrated by charts and diagrams.

J. N. Rose: *Exhibition of Venezuelan plants and fruits.*

Dr. Rose had on exhibition a large tableful of fruits, fruit products, and various articles made of parts of Venezuelan plants. He explained their use and described the plants from which they were obtained. The specimens were obtained for the most part in the vicinity of La Guaira and Caracas. Dr. Rose's communication was discussed by Messrs. H. Pittier, M. W. Lyon, Jr., and others.

M. W. Lyon, Jr.: *Poisonous snakes.*

Dr. Lyon gave an account of the various specific substances that have been found in snake venoms, and outlined their modes of action on the various tissues of bitten animals. He spoke of the various antiserums that have been prepared against these venoms, and their therapeutic uses. He called attention also to the non-specific treatment of snakebites in the light of modern statistics and experiments. He then gave a brief outline of the classification of venomous snakes, and discussed their geographic distribution and the development and structure of the poison gland and fang. His communication was illustrated by lantern slide views of skulls, glands, and fangs of poisonous snakes, of types of poisonous snakes, and of some of the histological changes caused by snake venom. It was discussed by Messrs. A. A. Doolittle, H. Pittier, H. M. Smith, H. E. Ames, and T. E. Wilcox.

The 562d regular and the 37th annual meeting of the Society was held at the Cosmos Club, Saturday, December 16, 1916; called to order by President Hay at 8 p.m. with 23 persons present.

Annual reports of officers and committees were submitted. Election of officers for the year 1917 resulted as follows: *President,* W. P. Hay; *Vice-presidents,* J. N. Rose, A. D. Hopkins, Hugh M. Smith, Vernon Bailey; *Recording Secretary,* M. W. Lyon, Jr.; *Corresponding Secretary,* W. L. McAtee; *Treasurer,* Ned Dearborn; *Members of Council,* N. Hollister, J. W. Gidley, William Palmer, Alex. Wetmore, E. A. Goldman. President Hay was nominated as vice-president of the Washington Academy of Sciences.

Ex-president B. W. Evermann then gave an illustrated lecture regarding the present condition of the museum of the California Academy of Science and its aims and aspirations. This was discussed by Messrs. E. W. Nelson and Vernon Bailey.

M. W. Lyon, Jr., *Recording Secretary.*

Digitized by Google
Original from HARVARD UNIVERSITY

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 500th meeting of the Society was held at the New National Museum, October 17, 1916, at 4.30 p.m. Dr. WALTER HOUGH, of the National Museum, read a paper on *Ancient pit dwellers in New Mexico.*

Dr. Hough said that remains of pit dwellings were indicated on the site of stone ruins explored in western Socorro County, New Mexico, several years ago and that a large cluster of such dwellings not connected with stone ruins was observed subsequently near Luna, in Socorro County. The site was productive of interesting results during an exploration for the Bureau of American Ethnology last summer. The field in which the remains occur had been smoothed over by natural agencies and the positions of the houses were shown only by the stronger growth of vegetation over circular areas, this defining the pits. Some of the pits were cleared, and it was found that they were from 12 to 14 feet in diameter and 5½ feet deep. Remains of roof clay and charred posts and beams indicate that the roof was supported on posts placed around the periphery of the pit. It is thus probable that more than half of the house was underground, and perhaps the position of the walls above ground were banked. The floor arrangement shows a fireplace near the center, a metate and grinding stones near the fire. In one of the pits a burnt clay wall fireplace was found. Adjoining the pits was a rectangular house also rooted with clay. Here were found numerous grinding stones, baking slabs, and remains of pottery, these being about a foot under the surface loam. This house was an open air cooking and mealing shed. Near the first pit excavated was a cemetery of infants; no remains of adults have yet been found on the site.

A dance amphitheater which was about 100 feet in diameter and 10 feet deep lies on the east side of the site. It has been filled by natural agencies with about 5 feet of fire-blackened débris and in it large pine trees have matured. It is on the bank of the former and larger channel of a living stream which traverses the eastern edge of the site. The specimens found are crude metates, rubbing stones, hammer stones, baking slabs, etc.; pottery of Pueblo type, decorated and undecorated and of some crudity; a few bone awls and small obsidian arrowheads. No stone axes were found.

Dr. Hough presented the problem as he found it, and hesitated as yet to pronounce upon the affiliations of the people who constructed the pit houses.

The 501st meeting of the Society was held in the Lecture Hall of the Public Library, on Tuesday evening, November 7, 1916, at 8 o'clock. The speaker was Mr. W. E. SAFFORD, of the Bureau of Plant Industry, U. S. Department of Agriculture. His subject was *Magic plants of the ancient Americans.* The paper was illustrated with lantern slides.

Digitized by Google Original from HARVARD UNIVERSITY

Mr. Safford said that the practice of magic was widely spread in both North and South America in pre-Columbian times, and in connection with it certain plants, principally those having narcotic properties, were used ceremonially, often as incense, or to produce hallucinations, to call up the spirits of the dead, and to expel evil spirits from the sick and insane. The priest of the Temple of the Sun at Sagomozo, in the Andes of South America, prophesied and revealed hidden treasures while in a state of frenzy caused by the seeds of a tree datura (*Brugmansia sanguinea*). This recalls similar practices of the priestesses of the oracle at Delphi. Another Peruvian plant with marvelous properties described by early explorers was *Erythroxylon Coca*, from which the valuable alkaloid cocaine is now obtained. Bags of its leaves accompanied by little gourds containing lime were found by the author in many graves near the Peruvian coast, hanging about the necks of the mummified remains of the dead. On the opposite coast of South America, or rather in Paraguay, grew the highly esteemed *Ilex paraguariensis*, or *yerba mate*. Closely allied to it is the *Ilex vomitoria* of the southeastern United States, from which the Indians made the famous "black drink," used ceremonially as a magic physic, which purged them from evil and which was used also in initiating their youths into manhood. Professional priests, or necromancers, were encountered by Columbus and his companions on the island of Hispaniola, who induced intoxication and called up their *zemi*, or gods, by means of a narcotic snuff, called *cohoba*, inhaled through the nostrils by means of a bifurcated tube. This snuff, hitherto believed to have been tobacco, has been identified recently by the author as the powdered seeds of a Mimosa-like tree, *Piptadenia peregrina*, still used in a similar way by various South American tribes of Indians, by some of whom an infusion of the seeds is also used to induce intoxication, administered as an enema by means of a pear-shaped syringe of caoutchouc. In Mexico, the early missionaries, who were called upon to stamp out the practice of witchcraft, found that the Aztecs paid divine honors to various plants, especially to *huauhtli* (a white-seeded Amaranthus); *ololiuhqui* (a Datura); *peyotl* (a spineless cactus, *Lophophora Williamsii*) also called *teonanacatl*, or "Sacred Mushroom;" and *picietl* (tobacco). Of *huauhtli* seeds, ground to a paste with the syrup of maguey, images were made and adored, and afterwards broken into fragments and served as a kind of communion. This seed was produced in such quantities that it was used in paying tribute to Montezuma, at the time of the Conquest. The *ololiuhqui* was regarded as divine, and it was considered a holy task to sweep the ground where it grew. Its spirit, addressed as the Green Woman (*Xoxouhqui Cihuatl*), was invoked to expel certain diseases and to overcome weaker and inferior spirits in possession of a sick person. It is interesting to note that the use of the *ololiuhqui*, or *toloatzin*, as it was also called (*Datura meteloides*), still prevails among the Zuñi Indians of New Mexico, the Pai-Utes, and several tribes of southern California in certain religious and ceremonial practices, especially in initiating youths into the status

Digitized by Google Original from HARVARD UNIVERSITY

of manhood. The *peyotl*, or *teonanacatl*, called by Bancroft the "flesh of the gods," was used by the Aztecs in nocturnal feasts, very much as it is still used by Indians of the Mexican Sierra Madre and by certain tribes of the United States, who believe the visions induced by it to be supernatural. In ancient times a supply of this little narcotic plant was obtained by runners especially consecrated for the purpose, and its gathering was attended by a most formal ceremony. At the present day it is sent from the locality where it grows, along the Rio Grande, by means of parcel post. Lastly, the ceremonial and religious use of *picietl*, or tobacco, goes back to remote antiquity. No other narcotic plant, perhaps, has become so widely spread or so generally used and beloved by its votaries. Though of subtropical origin its cultivation had extended before the Discovery as far north as the St. Lawrence River. Beautiful pipes of many forms, representing birds, mammals, human heads, etc. have been discovered in Indian mounds near the native city of the speaker, Chillicothe, Ross County, Ohio; and more recently in Scioto county farther to the south.

In addition to the above plants may be mentioned a certain small scarlet bean, the seed of *Sophora secundiflora*, endemic in northern Mexico and southern Texas. This also has narcotic properties, and was so much sought after by certain tribes of Indians that they have been known to exchange a pony for a string of the beans 6 feet in length. In one of the secret societies of the Iowa Indians this bean is used in the initiating ceremonial; the beans are carried as charms or amulets by the members of the society, just as in western Mexico fragments of the *peyotl*, and in southern California parts of the Datura, are carried by their votaries, who believe them to be efficacious against danger and to bring good luck in hunting and war. It is interesting to note a similar practice in the Old World of carrying the root of Mandragora (or a substitute for it) as an amulet; but most interesting of all is the similarity between the beliefs and practices of the inhabitants of the Old World and the New, in connection with narcotic and other plants held to possess magic properties. The lantern slides used to illustrate the lecture were photographs of the various magic plants discussed.

This paper was discussed by Mr. James Mooney, who for a number of years has given special study to the subject of *peyotl*. Mr. Mooney defended those who are devoted to the peyotl ceremony and claimed that, in most cases, the assertions made against the plant and its users are based upon ignorance of the facts and are without foundation.

The 502nd meeting of the Society was held at the New National Museum on Tuesday afternoon, November 21, 1916, at 4.30 o'clock. Mr. Neil M. Judd, of the U. S. National Museum, presented a paper on *New types of Pueblo ruins found in western Utah*, illustrating his paper with chalk drawings.

Mr. Judd described a recent archeological reconnaissance of western Utah conducted under the auspices of the Bureau of American Ethnology, stating that this resulted in the discovery of two types of pre-

Digitized by Google Original from HARVARD UNIVERSITY

historic habitations not previously reported from the Southwest. The first of these was circular in form and was made by leaning logs against cross-pieces supported by four uprights which surrounded a central fire-place. Willows, grass, and clay, in succession, covered the logs. Houses of the second type, occurring usually in groups forming villages, were rectangular in shape and constructed entirely of adobe. A small series of unattached cliff-dwellings, exhibiting certain features common both to structures of this second type and to stone-walled houses south and east of the Rio Colorado, was also described. A careful study of the lesser artifacts recovered from both types of western Utah ruins indicates a close cultural relationship between their respective builders and the inhabitants of prehistoric structures in other sections of the Southwest.

In a discussion of the paper Dr. J. W. FEWKES called attention to the desirability of a more accurate definition of what archeologists mean by a "pueblo." He pointed out that the term is sometimes used loosely to include all kinds of ruined stone buildings in the Southwest. Inasmuch as the pueblo culture area owes its name to characteristic buildings or pueblos, he suggested that the term be limited to terraced, congested community buildings with ceremonial rooms or kivas. If this suggestion were accepted by archeologists, many ruins on the periphery of the so-called Pueblo area would have to be classified as belonging to a prepuebloan phase, or not regarded as pueblos at all.

The 503rd meeting of the Society was held in the Lecture Hall of the Public Library on Tuesday evening, December 5, 1916, at 8 o'clock. At this meeting Prof. W. H. HOLMES, of the U. S. National Museum, delivered an address on *Outlines of American aboriginal history*, illustrated with lantern slides.

Introducing his subject, Professor Holmes said it is agreed that the human race is a unit, and that it follows, therefore, that there was but one cradle and that man spread from this over the world. The early chapters of human history must always remain obscure, although evidence has been found carrying the story far back into the remote past. It was the purpose of the speaker to indicate briefly the probable course taken by the human race in spreading from the Asiatic cradle to the New World, and also to indicate the causes and course of cultural development in the various centers of American occupancy and to suggest the causes of decline.

The earliest known traces of man (or man-like being) have been found on the island of Java. In the nature of things, it was a long time before he wandered far from his primeval home. He had to acquire the arts of the hunter and fisher before he could reach the far north and it was doubtless by way of Bering Strait that he reached the New World. Portraits were shown of the various peoples whose ancestors may have been concerned in these ancient migrations—natives of Tibet, China, and Siberia, the Eskimo, the Sioux, the Zuñi, and other typical American Indians; and attention was directed to the

Digitized by Google Original from HARVARD UNIVERSITY

practical identity of these types. Referring to the development of culture in America it was shown that no culture above the hunter-fisher stage ever passed through the Bering gateway. All culture of higher grade is, therefore, American. As the early immigrants reached the more favorable localities of the continent, they engaged in agriculture and became sedentary. This condition led to the development of the simple arts, industries, and institutions belonging to this phase of progress. It was asked, How then do we account for the vast works in the way of temples, pyramids, and tombs, and the vast body of products of the sculptor's art, of highly embellished pottery, textiles, and metallurgy? It was shown that all were due to the dynamic forces of religion manifested through the all-powerful shamanistic classes, who sought above all things to honor the gods and to glorify themselves. But, it was asked, Why are the once splendid cities now in ruin? The reasons are readily found: The energies of the people were broken down by the ever increasing load of super-essential activities. The system which permitted over-growth of these highest manifestations of culture had within itself the germs of disaster.

Numerous slides illustrating various wonderful products of sculptural and architectural genius developed under the absolute control of the Mayan shamanistic priesthood were shown.

The paper was discussed by Dr. E. Hewett, of Santa Fe, N. M., Mr. S. G. Morley, of Cambridge, Mass., and Dr. H. J. Spinden, of New York. Dr. Hewett suggested the influence of environment on the cultural development of a race, citing the discovery of metal by the early inhabitants of Europe and its use in making weapons. Mr. Morley spoke of the Maya hieroglyphs, and Dr. Spinden discussed the culture which preceded that of the Maya in Central America, traces of the agricultural period remaining in crude figurines, and that of the religious period in effigies of serpents and of grotesque gods.

The 504th meeting of the Society was held at the New National Museum, December 19, 1916 at 4.30 p.m. Dr. Truman Michelson, of the Bureau of American Ethnology, presented a paper entitled *Notes on the Peoria Indians.*

Dr. Michelson said that the Peoria Indians have practically lost their ethnology, in the strictest sense of the word, although their language and folklore still remain. A study of these shows very clearly that the Peoria Indians have had two associations, the older and more intimate association being with the Ojibwa group of central Algonkins and the more recent with the Sauk, Fox, and Kickapoo. The terms of relationship support this view, as do the historical facts.

The speaker then showed by means of a blackboard chart the system of consanguinity among the Peoria. In this way it was demonstrated that two factors were involved, i.e., the gentile organization and blood consanguinity.

The paper was followed by a general and interesting discussion. Prof. W. H. Holmes mentioned the old quarries in northeastern Okla-

Digitized by Google Original from HARVARD UNIVERSITY

homa, near the present location of the Peoria Indians, and Dr. ALEŠ HRDLIČKA noted the importance of definite recording of the geographic distribution of Indian tribes. In reply to a question by Mr. F. W. HODGE the speaker expressed the opinion that archeological research would throw light on the early material culture of the Peoria. Dr. J. R. SWANTON noted that the Indians of the Northwest coast have a myth similar to one related by the speaker, in which bones thrown into the water are said to "come to life." In the legend of the coast Indians the bones are those of a salmon, while among the Peoria the bones are those of a beaver. In response Dr. Michelson stated that the form of this legend which mentions the beaver is limited to a small area.

FRANCES DENSMORE, *Secretary.*

Digitized by Google Original from HARVARD UNIVERSITY

ANNOUNCEMENT OF MEETINGS OF THE ACADEMY AND AFFILIATED SOCIETIES[1]

Saturday, January 20: The Philosophical Society, at the Cosmos Club, at 8.30 p.m. Program:

L. J. BRIGGS: Presidential address.—*The living plant as a physical system.*

Wednesday, January 24: The Medical Society, at the Medical Department of the George Washington University, 1325 H Street N. W., at 8 p.m.

Wednesday, January 24: The Geological Society, at the Cosmos Club, at 8 p.m. Program:

D. F. HEWETT: *The nature of bertonite, and the geologic range of related material in the Big Horn Basin, Wyoming.* 20 minutes.

J. C. HOSTETTER: *The linear force of growing crystals.* 20 minutes. Illustrated.

J. W. GIDLEY: *Origin of the mammals.* 20 minutes. Illustrated.

Saturday, January 27: The Biological Society, at the Cosmos Club, at 8 p.m.

Wednesday, January 31: The Medical Society, at the Medical Department of the George Washington University, 1325 H Street N. W., at 8 p.m.

[1]The programs of the meetings of the affiliated societies will appear on this page if sent to the editors by the thirteenth and twenty-seventh days of each month.

Digitized by Google

Original from
HARVARD UNIVERSITY

CONTENTS

Original Papers

Page

Mineralogy.—Magnesioludwigite, a new mineral. B. S. Butler and W. T. Schaller 29

Anthropology.—Significance of the terms for brother and sister among primitive peoples. John R. Swanton 31

Abstracts

Physics 36

Geology 36

Paleontology 39

Technology 39

References

Chemistry 40

Mammalogy 40

Technology 42

Proceedings

The Botanical Society 44

The Biological Society 45

The Anthropological Society 47

Digitized by Google

Original from HARVARD UNIVERSITY

L. Soc. 146. 230. 15

Vol. VII | No. 6

March 19, 1917

LIBRARY
PEABODY MUSEUM
RECEIVED
NOV 3 1955

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

BOARD OF EDITORS

N. Ernest Dorsey, Bureau of Standards
Adolph Knopf, Geological Survey
A. S. Hitchcock, Bureau of Plant Industry

PUBLISHED SEMI-MONTHLY
EXCEPT IN JULY, AUGUST, AND SEPTEMBER, WHEN MONTHLY

BY THE

WASHINGTON ACADEMY OF SCIENCES

OFFICE OF PUBLICATION
WILLIAMS & WILKINS COMPANY
BALTIMORE, MD.

Entered as second-class matter July 14, 1911, at the post office at Baltimore, Maryland, under the Act of July 16, 1894

Digitized by Google | Original from HARVARD UNIVERSITY

Journal of the Washington Academy of Sciences

This JOURNAL, the official organ of the Washington Academy of Sciences, aims to present a brief record of current scientific work in Washington. To this end it publishes: (1) short original papers, written or communicated by members of the Academy; (2) a complete list of references to current scientific articles published in or emanating from Washington; (3) short abstracts of certain of these articles; (4) proceedings and programs of meetings of the Academy and affiliated Societies; (5) notes of events connected with the scientific life of Washington. The JOURNAL is issued semi-monthly, on the fourth and nineteenth of each month, except during the summer when it appears on the nineteenth only. Volumes correspond to calendar years. Prompt publication is an essential feature; a manuscript reaching the editors on the second or the seventeenth of the month will ordinarily appear, on request from the author, in the next issue of the JOURNAL.

Manuscripts may be sent to any member of the Board of Editors; they should be clearly typewritten and in suitable form for printing without essential changes. The editors cannot undertake to do more than correct obvious minor errors. References should appear only as footnotes and should include year of publication.

Illustrations will be used only when necessary and will be confined to text figures or diagrams of simple character. The editors, at their discretion, may call upon an author to defray the cost of his illustrations, although no charge will be made for printing from a suitable cut supplied with the manuscript.

Proof.—In order to facilitate prompt publication no proof will be sent to authors unless requested. It is urged that manuscript be submitted in final form; the editors will exercise due care in seeing that copy is followed.

Authors' Copies and Reprints.—On request the author of an original article will receive gratis ten copies of the number containing his contribution and as many additional copies as he may desire at five cents each. Reprints will be furnished at the following schedule of prices:

	4 pp.	8 pp.	12 pp.	16 pp.
50 copies	$1.08	$1.95	$2.93	$3.80
100 copies	1.30	2.40	3.60	4.70
Additional copies, per 100	.45	.90	1.35	1.70

Covers bearing the name of the author and title of the article, with inclusive pagination and date of issue, will be $2.00 for the first 100. Additional covers $1.00 per 100.

As an author may not see proof, his request for extra copies or reprints should invariably be attached to the first page of his manuscript.

The rate of Subscription per volume is	$6.00*
Semi-monthly numbers	.25
Monthly numbers	.50

Remittances should be made payable to "Washington Academy of Sciences," and addressed to the Treasurer, William Bowie, Coast and Geodetic Survey, Washington, D. C., to Williams & Wilkins Company, 2419–2421 Greenmount Ave., Baltimore, Md., or to the European Agents.

European Agents: William Wesley & Son, 28 Essex St., Strand, London, and Mayer and Müller, Prinz Louis-Ferdinand Str., Berlin.

Exchanges.—The JOURNAL does not exchange with other publications.

Missing Numbers will be replaced without charge, provided that claim is made within thirty days after date of the following issue.

* Volume I, however, from July 19, 1911 to December 19, 1911, will be sent for $3.00. Special rates are given to members of scientific societies affiliated with the Academy.

THE WAVERLY PRESS
BALTIMORE, U. S. A.

Digitized by Google
Original from
HARVARD UNIVERSITY

JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

Vol. VII MARCH 19, 1917 No. 6

ELECTROCHEMISTRY.—*The electrometric titration of zinc with ferrocyanide.* F. RUSSELL v. BICHOWSKY, Geophysical Laboratory. (Communicated by Arthur L. Day.)

The purpose of this note is to point out a set of very interesting polarization phenomena that occur at a platinum electrode when certain insoluble salts, such as zinc, ferric copper, lead, or manganous ferrocyanide, are being precipitated. Only the case of zinc ferrocyanide will be discussed here.

If we place a platinum electrode in a solution of potassium ferrocyanide and titrate this solution with a solution of some zinc salt the e.m.f. of the electrode measured against some standard electrode, such as the normal calomel electrode, follows a perfectly normal curve beginning at about $-$ 0.08 volt (the e.m.f. of the ferrocyanide electrode) and increasing slowly with the addition of the zinc solution until near the end point; on the addition of a drop in excess of the amount of zinc solution necessary to precipitate all the ferrocyanide the e.m.f. increases very sharply to $-$ 0.40 volts. With further excess the e.m.f. stays approximately constant, reaching a maximum value of about $-$ 0.45 volts. The electrometric end point is thus very sharp, and the platinum electrode is by all means the most accurate and convenient device for determining the end point of the zinc ferrocyanide titration.

However, if instead of adding zinc solution to a ferrocyanide solution we reverse the process and add ferrocyanide to the

Digitized by Google Original from HARVARD UNIVERSITY

zinc solution, the initial e.m.f. of the platinum electrode, instead of having the invariant value of − 0.45 volts can be made to have almost any value between 0.0 and − 0.5 volts, depending on the previous treatment of the electrode. If the electrode has been allowed to stand in contact with a ferrocyanide solution for some time the e.m.f. will be between − 0.1 and − 0.25 volts, depending on the length of time it has been in the solution; if it is charged to say − 2.0 volts while in contact with a zinc solution the initial e.m.f. of the electrode may reach the reversible value of − 0.45 volts, or even higher.

If the electrode has been adjusted to an e.m.f. of − 0.45 volts and the titration of zinc with ferrocyanide carried through as before, the exact reverse of the previous curve is obtained, the e.m.f. begins at − 0.45 volts, drops sharply at the end point to − 0.10 and continues at nearly that value on further addition of ferrocyanide. In this case, therefore, our initial curve is reversible. If, however, the platinum electrode has been treated so that it shows an initial voltage of say − 0.20 volts, on adding the ferrocyanide solution the numerical value of the e.m.f. increases slowly, instead of decreasing, this increase continuing until the curve that is obtained by plotting e.m.f. against cc. of ferrocyanide added intercepts the normal curve. At this point the e.m.f. is a maximum. From this point on the e.m.f. curve is entirely normal, the end point being perfectly sharp and unchanged. This phenomenon is similar to the one noted by Forbes and Bartlett[1] for the titration of ferrous iron with dichromate, but in our case not only is it possible to avoid the phenomenon entirely by the proper treatment of the electrode already indicated, but it is also possible not only to control the initial e.m.f. of the electrode, but also the shape and slope of the ascending (abnormal) part of the curve, thus causing the point of interception of the abnormal and normal curve to be varied. In a well stirred solution the abnormal curve starting at − 0.2 volts will almost always intercept the normal curve just before the end point is reached, however, if the stirring is made very

[1] Journ. Amer. Chem. Soc., **35**: 1527. 1913.

Digitized by Google

Original from
HARVARD UNIVERSITY

poor so that there is any large excess of ferrocyanide in contact with the electrode before the zinc is all precipitated, the end point can be suppressed entirely; or, if by various devices the titration is carried on so that the electrode is always in contact with small concentrations of both zinc and ferrocyanide ion, the point of interception of the normal and abnormal curve can be moved almost to the beginning of the titration, the titration curve thus having a very flat rather than the usual sharp maximum. Of course, in all these cases, except in the case of no stirring, the end point is perfectly sharp and reproducible, and under any of these varied conditions this method of determining the end point is much more rapid, convenient, and accurate than those employing the usual indicators (iron or uranium).

All these phenomena seem to show that in cases of this type depolarization can be accomplished only by some agent (in this case ferrocyanide, in Forbes and Bartlett's case, ferrous iron) whose oxidation and reduction reactions on the platinum electrode are reversible, and that the persistent irreversibility of the Forbes and Bartlett curve and of our curve was due simply to the fact that the only substance in the solution capable of rapid reversible reaction at the electrode was removed from the possibility of acting—by precipitation in our case, and by the excess of an irreversible strong oxidizing agent in Forbes and Bartlett's case. This explanation is independent of any theory of the cause of polarization

MINERALOGY.—*Neodymium as the cause of the red-violet color in certain minerals.*[1] EDGAR T. WHERRY, U. S. National Museum.

Impressed by the intense red-violet color shown by the permanganates, many chemists are inclined to interpret the similar colors occasionally shown by normally colorless minerals, such as calcite and apatite, as due to the presence of manganese. Of course, permanganates may be at once excluded from consideration, for they can only be produced by a somewhat vio-

[1] Published by the permission of the Secretary of the Smithsonian Institution.

Digitized by Google Original from HARVARD UNIVERSITY

lent process—fusing with alkalies and then acidifying—in the course of which the minerals would be destroyed; moreover they are extremely unstable, and even if formed could hardly persist long. Finally, permanganates show a highly characteristic absorption spectrum—observable by placing their solutions between a source of white light and the slit of a spectroscope—consisting of six bands in the yellowish green, green, and greenish blue; but not a trace of this absorption spectrum is shown by any mineral thus far studied.

Certain manganic compounds, containing trivalent manganese, are, however, also red-violet in color, and may develop in minerals under mildly oxidizing conditions. Even colorless bottle-glass, on lying out in the sunlight for a time, becomes red-violet owing to the oxidation of the manganese to that valency.[2] Such manganic compounds show a single rather hazy absorption band in the greenish blue, but only indistinct general absorption of the colors complementary to red-violet.

On the other hand, there is at least one other chemical element, the rare-earth metal neodymium, which has red-violet or violet-red colored compounds; and these yield a highly characteristic absorption spectrum, consisting of an intense band in the orange-yellow, a fainter one in the green, and, if sufficiently concentrated, additional ones in other parts of the spectrum. These bands can readily be seen if a solution of monazite in sulfuric acid is placed between the source of light and the spectroscope slit. They can also be observed in a number of minerals, by the use of the microspectroscope.[3] Of course if the mineral occurs in large enough masses, the ordinary spectroscope may be used, and the mineral be simply placed between the source of light and the slit; those described in this note give good results by this method.

It was pointed out by Headden some years ago[4] that the

[2] See Gortner, R. A. Journ. Amer. Chem. Soc., **30**: 157–162, 1908.

[3] See the writer's paper, *The microspectroscope in mineralogy*, Smithsonian Misc. Coll., **65**, No. 5, 1915.

[4] Am. J. Sci., [4] **21**: 301, 1906.

Digitized by Google Original from HARVARD UNIVERSITY

red-violet[5] calcite from Joplin, Missouri, gives this neodymium absorption spectrum. This was confirmed by the writer in the paper referred to, and in addition it was noted that the red-violet calcite from Rossie, New York, shows, faintly, the same spectrum. Specimens from Sterlingbush, New York, recently received by the National Museum in exchange from the New York State Museum, have the same color as the latter occurrence, and show the same absorption spectrum.

That manganese is not the cause of the color of these calcites is shown by the following considerations: The calcites contain ferrous iron, and must accordingly have been formed under reducing rather than oxidizing conditions, so that any manganese present must be in the manganous state. Now manganous carbonate, the mineral rhodochrosite, is pure red in color, and that this color is not essentially changed by association of the manganese with calcium is evident from the pale red color of the so-called manganocalcite, such as occurs for instance at Franklin Furnace, New Jersey. Furthermore, many calcites known to contain moderate amounts of manganese show no color whatever. The minute trace of manganese present in these red-violet calcites could therefore not by any possibility produce their color.

There is thus both positive evidence (the absorption spectrum) and negative evidence (the inability of manganese to produce the color) in favor of the view that red-violet calcite in general owes its color to neodymium.

The mineral apatite is sometimes violet in color, but, as recorded in the writer's paper above cited, usually shows no absorption spectrum. Oddly enough the well known brown apatite from Ontario, Canada, yields the absorption bands of neodymium, although any red-violet color that this metal produces is masked; most of the crystals show an underlying green color, due presumably to ferrous iron, the brown being only a sort of local mottling which could readily be produced by irregular distribution of a pale red-violet coloring matter.

[5] An effort was made to name the colors of these calcites according to Ridgway's "Color standards and nomenclature," but accurate comparisons of colors seen only in thick layers of a transparent mineral and those painted on sheets of paper are impracticable. The approximate position of the calcite colors is, however, 67, violet-red, composed of red 52 per cent, violet, 48 per cent.

Digitized by Google

Original from HARVARD UNIVERSITY

It would naturally be expected that an occurrence of neodymium-bearing apatite free from the green color of ferrous iron would actually show the red-violet; which expectation has now been fulfilled. The U. S. Geological Survey has recently transmitted to the National Museum an extensive series of minerals collected by Dr. W. T. Schaller in the pegmatites of southern California, among which are two kinds of violet apatite. One, the color of which is pure violet, from the Mountain Lily Mine, Oak Grove, agrees with apatites from Maine and Saxony, previously examined, in color and in absence of absorption spectrum; no guess will here be hazarded as to the cause of its color. But the other, from the San Diego Mine, Mesa Grande, has a red-violet color similar to that of the Joplin calcite, and shows an even more intense absorption spectrum, so is to be regarded as also owing its color to neodymium.

GENETICS.—*A correlation between endosperm color and albinism in maize.* J. H. KEMPTON, Bureau of Plant Industry. (Communicated by G. N. Collins.)

Seedlings in which chlorophyll does not develop occur not infrequently in many cultivated species. Such plants are known as albinos. As photosynthesis is impossible without chlorophyll these seedlings soon perish. Some varieties of maize produce many albino seedlings, and it has been possible to isolate strains which give regularly a certain proportion of albino seedlings. Several investigators have tested the exactness of the ratio between normal and albino plants and have concluded that albinism is a simple Mendelian character, recessive to the normal form.[1]

[1] EAST, E. M., and HAYS, H. K. *Inheritance in maize.* Conn. Agr. Exp. Sta. Bull., clxvii, 1911.

EMERSON, R. A. *The inheritance of certain forms of chlorophyll reduction in corn leaves.* Nebr. Agr. Exp. Sta. Twenty-fifth annual report. 1912.

GERNERT, W. B. *The analysis of characters in corn and their behaviour in transmission.* Published by author, 1912.

MILES, FRANK C. *A genetic and cytological study of certain types of albinism in maize.* Journal of Genetics, 4: 193. 1915.

Digitized by Google

Original from
HARVARD UNIVERSITY

In studying the effects of temperature and light upon the rate of elongation of albino seedlings the writer had occasion to grow seedlings from an ear which had both yellow and white seeds, and found what appears to be a correlation between the color of the endosperm in the seed and the development of chlorophyll in the seedlings. The ear from which this seed was secured was the result of a self-fertilized first generation plant of a cross between *Zea tunicata* and *Zea ramosa*. This cross has been recently described in detail by Mr. Collins.[2]

The ear was non-podded and had approximately three yellow seeds to one white. The actual figures were 70 yellow and 18 white. These yellow seeds were similar to those reported by other investigators of yellow endosperm in that they varied greatly in the intensity of the color, but in this instance little difficulty was encountered in segregating the white seeds. The 70 yellow seeds were divided into four groups with respect to the intensity of the color, the two darkest groups having 18 seeds each, and the two lightest groups having 17 seeds each.

TABLE 1

	NORMAL	ALBINO
Dark yellow	17	1
Yellow, grade 1	16	2
Yellow, grade 2	13	4
Yellow, grade 3	11	6
White	6	12
Total	63	25

Fortunately every seed germinated and it was immediately seen that there was a correlation between white or colorless endosperm and albino seedlings. The percentage of albino seedlings from the yellow seeds is 18.6, while the white seeds produced 61.5 per cent albinos. Had we been growing only the white seeds from this ear a very misleading conception of the ratio of albino to normal plants would have resulted. It is also

[2] COLLINS, G. N. *Hybrids of Zea ramosa and Zea tunicata.* Read at the meeting of American Naturalists, New York, December 29, 1916.

Digitized by Google Original from HARVARD UNIVERSITY

obvious that in a population of yellow and white seeds having an association between white endosperm and albinism the percentage of homozygous yellow plants would be greatly increased owing to the differential death rate between the yellow and white.

The five classes of seeds planted with the resulting seedling classes are shown in Table 1.

Arranged in the form of a fourfold table by combining the four grades of yellow the classes are as shown in Table 2.

TABLE 2

	NORMAL	ALBINO	TOTAL
Yellow	57	13	70
White	6	12	18
Total	63	25	88

The coefficient of association by Yule's method[3] is 0.795 ± 0.072 which is certainly too large to be ascribed to chance.

Using Pearson's formula[4] for the mean square contingency, $C_2 = 0.395 \pm 0.057$, which is a deviation above a zero correlation of 6.9 times the error. Although the number of individuals is small, the fact that the proportion of albino seedlings increased as the intensity of the endosperm color diminished may be of some significance. If it is assumed that the differences in shade between the four classes of yellow endosperm are due to separate factors, it would seem that these several factors are correlated with albinism, which on the linkage hypothesis would necessitate that these associated factors be located on the same chromosome.

As with many simple characters there are several degrees of albinism which grade from white to yellow by imperceptible stages. The present albino seedlings, while they were easily separated from the normal plants, varied among themselves from almost pure white to an appreciable amount of yellow.

[3] Yule, G. Udny. *On the methods of measuring association between two attributes.* Journal Royal Statistical Society, **75**, Part VI, May, 1912.

[4] Pearson and Heron. Biometrika, **9**: 167. 1913.

Digitized by Google Original from HARVARD UNIVERSITY

As the total number of albino seedlings was small no attempt was made to classify the degrees of albinism in relation to the degrees of endosperm color.

The inheritance of endosperm color has been studied by several investigators who have concluded that this character is composed of at least two factors. The results are not easily interpreted even with two factors, the investigations revealing many complications, and it is possible that these may be due at least in part to a linkage between the several factors for endosperm color.

The present correlation may be considered in the nature of a coherence since it is highly probable that the albino character and white endosperm were brought into this cross from the tunicate parent. The progeny of a self-pollinated ear from a sister plant of the male parent of the cross between *Zea ramosa* and *Zea tunicata* was noted in 1916 as having produced many albino plants. The yellow endosperm undoubtedly came from the ramosa parent and thus far no albino seedlings have been found in the strain of *Zea ramosa* we have been growing.

There is, however, the possibility that this apparent coherence is in reality a physiological correlation between white or albino endosperm and albino seedlings. As a demonstration of the truth or fallacy of this statement a strain having yellow endosperm, and producing gametes carrying the albino character should be crossed with a white strain lacking the albinistic tendency, but the final results of such a cross cannot be obtained before the fall of 1918.

ETHNOLOGY.—*An initiation at Hano in Hopiland, Arizona.* J. WALTER FEWKES, Bureau of American Ethnology.

There are three pueblos on the East Mesa of the Hopi Indians called Walpi, Sitcomovi, and Hano. These villages, situated in Northeastern Arizona, are composite in population and have been affected in different degrees by influx of clans from different directions the former homes of these clans now indicated by ruins. The inhabitants of Walpi are homogeneous. Sitcomovi, originally settled by clans from Zuñi, has lost the Zuñi

Digitized by Google
Original from
HARVARD UNIVERSITY

idiom, but still retains a ritual which is essentially Cibolan (Zuñian). The latter pueblo is regarded by the Zuñi as one of their pueblos among the Hopi, its architectural features being those characteristic of Tewa pueblos on the Rio Grande. Architecturally Hano is also Tewan, and its inhabitants retain the Tewa idiom, its mythology and ritual being distinctly Tanoan, little modified by the neighboring Walpi.

The general character of the rituals in these three villages is known, but very little has been published on the ritual of the relatives of the Hano people who now live along the Rio Grande, especially as to the nature of the initiations of youths into societies of priests. The Hopi introduce personifications of ancestors in their pagan dances, and call the personators by the name, Katcinas (Cachenas), but apart from that our knowledge is fragmentary. At Hano this worship formerly survived in its original form, so that the following pages may give an idea of the initiation of boys and girls into the Katcina cult as once practised, possibly still persisting, in villages along the Rio Grande.

The month of February is an active one ceremonially in the calendar of the Hopi towns. It is the month when lustration rites are performed to purify the earth from the malign influences of a power which through sorcery is supposed to rule it in winter. In that month, the return of the Katcinas, led by their father, the Sun or Sky-god, is personated. The clans that came to the Hopi from the south personate the return of their Sky-god in December, the clans of Sitcomovi in January, but the Katcinas are supposed to return in February and to remain about the villages until July, when their departure is celebrated in an extended farewell festival. The February ceremony is called, in secular language, the Bean Planting, because beans are sprouted in the kivas to be symbolically used by the returning Sun-god to represent the fructifying forces of nature. These sprouted beans are given at that time to the heads of all the clans by the personator of the Sky-god, in answer to their prayers, as a symbolic promise of good crops during the year.

Of the various steps in initiatory rites from birth to maturity, in the life of pueblo children, none is regarded more important

Digitized by Google Original from HARVARD UNIVERSITY

than the last, or that in which they are taught the mysteries of the Katcinas. A child under thirteen or fourteen years of age is not supposed to understand the nature of these supernatural beings, but to believe that from time to time family ancestors or spirits of the dead revisit the pueblos and receive prayers for the good of the tribe, after which they return to ghostly homes in the underworld, through the house of the sun far to the west. At this age they are among other things made acquainted with the fact that the Katcinas are not real supernatural beings, but personations by their own parents. But they must obtain this knowledge through initiation, some of the ordeals of which may be regarded as severe and are certainly calculated to bring out the moral courage of the novitiates. Many rites occur, one of which is a ceremonial flogging of children, which takes place in the presence of chiefs and other persons of the tribe. The rite at Hano, the subject of this article, has never been described.

To understand the meaning of this event and the place the Katcina cult occupies in the pueblo mind, it may be well to say a word on this subject before we pass to the consideration of the initiatory episode. In all their cults Hopi ceremonies show many indications of the worship of divinized ancestors, but this is especially true in those of the Katcina worship. The spirit dead are supposed to become Katcinas. The breath bodies of men pass to their future home, the underworld, a realm of the departed, presided over by the supernatural being called the God of Germs. The population of this underworld includes not only the spirits of those long ago deceased, but also those who have lately joined them. This ghostly population is supposed to have a social organization like that inhabiting the upper world, being as on earth divided into clans with related priesthoods, in all the conditions of life duplicating what is found among the living. There are male and female Katcinas, brothers, sisters, uncles, aunts, and various other relatives on the mother's side. The clans of the underworld, after death, bear names of the living, and are symbolically characterized. We have for instance, the Bear clan, the Badger clan, and others. Prominent among all members of each underworld clan are, the oldest members,

Digitized by Google Original from HARVARD UNIVERSITY

the ancestral parents of each clan, elevated to the cultus hero and heroine of the clan. The sun of course is father, and the earth, mother; they are common parents of all clans.

With this idea of the clan arrangement of the dead in the underworld let us consider their relation to the living clans, for this is the foundation of this cultus. Clan relationship not being severed by death, the deceased members are regarded as still members of the clan, with the same obligation to the clan as when alive on earth. What is most important of all is that the powers of these spirit ancestors are regarded as most efficacious in answering the prayers of the living. In other words, the clansmen of earth of the Bear clan feel that by addressing prayers to their relatives in the underworld, they, with their aid, can bring about what they desire. This can be accomplished by the use of magic or other supernatural agencies. The personation of ancient members of the clans are "conjured up" to hear the petitions of those of their clan, still living.[1]

The February ceremonial has for its primary purpose a celebration of the advent of these ancestral personages, while that in July celebrates their return to their homes in the underworld. The flogging of the young initiates, like other ritualistic episodes, contain many archaic survivals that have a foundation in an early myth recounting how the cult hero was initiated by the Sun father, in like manner.

The flogging ceremony at Hano, here described, took place in the larger of the two kivas, or sacred rooms, just before sunset on the 14th of February, 1900. This rite has been witnessed more than once, but the variations are slight, at most, and have no great significance.

As with all pueblo ceremonies some time is occupied with preparation of the paraphernalia used, as it has to be renovated for the special purpose. The walls of the room were replastered, and its floor thoroughly swept; all secular objects, as blankets in progress of weaving, were rolled up and put away, and smaller

[1] These returning clan members are represented by living members, who, for the time being, believe that they really become the members of the spirit branch of the clan which they represent.

Digitized by Google Original from HARVARD UNIVERSITY

objects tucked in certain niches made in the wall for that purpose. Boxes containing soil, in which bean seeds[2] had been planted a week before, were concealed by a wagon sheet hung across the end of the room.

Three personators took the prominent parts in the child flogging, two of whom personated the great Sky-god and the third represented the earth, or old woman, who they believe makes the germs of life grow. The personator who flogs the children represents the father of all living on earth as well as inhabitants of the underworld.[3] An account of his costume may be instructive as embodying their symbolic conception of these supernaturals.

Each personator of the Sky-god wears on his head a mask-helmet, painted black, and adorned with clusters of feathers, long beards made of horsehair with attached feathers hanging from their chins. The body, upper arms, and thighs are painted, smut from the bottom of an old cooking pot serving for black paint. Markings are drawn with gypsum on the upper arms and thighs, and the legs and forearms are painted with the same material. Several ears of corn strung together form their belts from which, reaching to their knees, hangs a fringe of horsehair stained red, the body being naked. This crude representation of the Sky-god has the same symbolic marks as a wooden idol of this god on a Hopi altar, and is called Tuñwup Katcina.

The three personators dressed near a shrine outside the kiva on the trail below the pueblo and entered Hano from the east in order to preserve the illusion that they came from a distant place in the east, where the sun, whom they personify, rises. They entered the kiva where spectators had already assembled, and shortly after their appearance, the man personating the Earth-woman entered the room passing through the hatchway

[2] These beans were forced to sprout in midwinter in a superheated atmosphere of the kiva, and were carried later by the Sun-god to represent symbolically fructification of food plants. Children were formerly taught that these sprouting beans are brought by a supernatural being, not being permitted to know that they were raised by their parents in the kiva.

[3] These men belonged to Hano clans. There are two Sky-gods in their mythology, one representing the sun, and the other the moon.

Digitized by Google Original from HARVARD UNIVERSITY

down the ladder bearing a flat basket with sacred meal to be used in the ceremonies.

It was about four o'clock, in the afternoon, when Anote, the village chief of the pueblo, Hano, entered the kiva, bearing in one hand two wands made of the leaves of the yucca or century plant, in the other hand his medicine bowl and a badge, indicating his standing as a chief. He placed this badge on the floor and deposited his medicine bowl near it. He then poured into the latter a white liquid, making passes in sequence with his hand towards the six cardinal points: north, west, south, east, above and below. He then stripped off the spines from the margins and points of the yucca leaves, scooped some of the medicine from the bowl into one hand and drew the leaves through it. Aided by another man he tied several leaves together making two whips, which were laid on the placque containing the prayer meal brought by the old woman.

By this time spectators had begun to assemble in the room, each one taking his seat on the raised floor at one end of the room. When they were seated, a number of adults, men and women, each accompanied by a child, who carried an ear of corn called "mother" in one hand, filed into the kiva and seated themselves along the sides of the room. When all were gathered the chief began to construct a rude altar on the floor of the room. He first made a low ridge of sand a few inches high into which he planted, upright, a row of 20 wing feathers. In front of these feathers he outlined on the floor, with meal, three semicircular figures, side by side, representing rainclouds, and added parallel lines of meal symbolic of falling rain. On the middle raincloud figure he set upright the badge of his office. A few feet in front of these figures near the firehole, he outlined with a line of meal a square figure crossed by two diagonals, on the junction of which, in the middle, he laid two small feathers. Having completed these preliminaries the chief took his seat back of the line of feathers and gave the signal that he was ready for the rite to begin. Shortly after, steps were heard on the kiva roof above followed by a voice hooting down the opening or hatchway, demanding permission to enter. The chief mounted the ladder

Digitized by Google Original from HARVARD UNIVERSITY

and spoke to those above. Immediately there followed him down the ladder the two personators of the Sky-god, and a man dressed as an old woman. These three made a circuit around the fire hole six times, after which the earth woman personator holding the basket of meal and whips, took position near the bottom of the ladder, and the two Sky-gods stood, one on each side of the rectangular meal figure on the kiva floor. The latter then began a rapid dance bending and swaying their bodies and shouting to the assembled spectators. Each was then handed one of the yucca whips, previously prepared as mentioned above, after which they resumed their dancing, calling out loudly for the children to come and be flogged. In a short time a woman led forward a girl about 11 years old, whose garment had been removed from her back, and placed her within the square outlined with meal. One of the Sky-gods immediately struck the bared back with the yucca wand several times, all the while continuing to dance and shout. He than passed to the other side exchanging places with his companion and the foster mother bared her back and was flogged as her child had been before her. The two Sky-gods again exchanged places, and whips, as yet unused, were given to them, after which a man, possibly a father, led a boy forward, both stepping inside the rectangle of meal. The boy was first flogged on the back in the same manner as the little girl, and the father was struck several times also on legs and arms. As each person entered the space occupied by the meal figure he took a pinch of meal and, raising it to his lips, threw it toward the Sky-god, uttering an inaudible prayer. The flogging continued until four children, and as many foster parents, or the men and women accompanying the children, had been treated in this way. Generally the punishment was received by the children without a flinch, but one of the girls was frightened. The Sky-god was lenient, simply whirling his whip over her head, without striking.

At the close of the flogging of initiates, other children, mostly boys, not initiates, voluntarily came forward and stood with backs bared for the whips. They were struck, oftentimes rather severely. Then adults, one after another, including the old

Digitized by Google Original from HARVARD UNIVERSITY

chiefs, stood up and were flogged, in the same way. As each person passed to the altar after receiving the blows he took a little liquid from the medicine bowl or meal from the basket, rubbed it on his wounds, without a word, and took his seat on the floor. The personators then left the room, after which the chief spoke at length, in Tewa idiom, to the assembled people. The author did not understand Tewa, but was told by an interpreter that he spoke to them on the meaning of the rite. He may have explained that it was a dramatization of an old legend and that the floggers were their own relatives personating supernatural beings. Following the speech the spectators then crowded around the altar, dipped their hands in the medicine, and took a handful of meal with which they rubbed their bodies, as both liquid and meal are considered salutary. At the close of the ceremony the children were led out of the room by their parents to their own homes.

On February 15, the day subsequent to that in which the flogging above described was performed, there was celebrated at Walpi one of the most unusual of all rites of the Bean-planting festival. The main events of this ceremony were prayers to a supernatural being called Masauu, the god of planting, also known as the supernatural of the "surface of the earth." The dramatic reception of Masauu occurred in a Walpi kiva at 8 o'clock in the evening and lasted far into the night. It is such an unusual event, having been witnessed by the author but once, that although it has no direct connection with the child-flogging it is introduced here, for want of a more appropriate place.

On the night when Masauu's visit was personated all fires throughout the East Mesa were extinguished. No one was met in the streets. Women and children were in hiding in back rooms, and darkened house terraces were deserted, for the dread being is greatly feared by all the Hopi. Knowing that he was to be personated that night, the author resorted to the chief kiva, in Walpi, early in the evening, and found about 20 men engaged in decorating their bodies with white kaoline paint, drawing lines down their backs and legs and placing

Digitized by Google Original from HARVARD UNIVERSITY

great daubs of white on their cheeks and hair. None of these men were masked, but all claimed they personated sisters or brothers of Masauu. Shortly after the author's entrance they began to sing their songs, containing strains of fine archaic Hopi Indian music, closely resembling in their cadences the song sung by the antelope priests in the well-known snake dance. While these songs were being sung a priest came down the kiva hatchway bearing two large hollow gourds, the surfaces of which had been painted black, and spattered with a wash containing glistening hematite. Each gourd was large enough to fit over the head and both were later worn as helmets by personators of Masauu. With these gourds the same priest brought two planting sticks of ancient form and two flat basket plaques which were laid with great reverence alongside the masks, near the fire hole. At the advent of this man all those present ceased their singing and lighted their pipes for a formal smoke, during which the pipes were passed around, every man silently puffing clouds of smoke upon the masks. No one of that gathering spoke a word but each fervently prayed in sequence, beginning with the chief, at the conclusion of which they again returned to their usual songs. During these songs one of the chiefs raised the painted gourd helmet and talked directly to it praying for success of crops during the coming season. The songs rose and became so loud that no one could tell what was said, but the intent throughout were prayers to fertilize the fields that the corn might germinate and grow. Shortly after, while the men were still singing and the light of the fire had been shielded from all eyes by a blanket, in order to darken the room, a naked man silently and unannounced came down the ladder, not as is usually the case backwards holding on the rungs, but as one would descend a pair of stairs. Entering the room without making the customary request, "Am I welcome here?" he slipped around back of the row of singers, peering anxiously at the masks on the floor. He finally came to the front from his hiding and squatted by the fireplace. Cautiously he placed the strange human skull-like gourd helmet over his head, threw a rough blanket around his

Digitized by Google Original from HARVARD UNIVERSITY

neck over his shoulders, and taking a planting stick in his hands assumed the kneeling posture which the Hopi take when they are planting on their farms, kneeling on one knee with the stick held vertically in his two hands. A second man who entered the kiva, in the same way donned the other helmet and without a word took his position near his predecessor. The songs of the assembled priests then became more animated and finally died down to a low murmur and ceased. The two personators manipulating their planting sticks in rhythm kept time to the songs. At the conclusion of which the singers filed out of the kiva, but as each man passed the fireplace he placed in the flat basket on the floor by the side of the kneeling figures a feather, symbolic of a prayer, for a successful harvest. As the last man left the room he halted for a moment at the fireplace, with one foot on the ladder rung and announced that in the spring, at planting time, a great ceremony to the planting god would occur in the fields to the west of Walpi. The prayers throughout this rite were particularly fervent, but so low they could not be heard even a few feet away. There was no loud talking and the faces of all were very serious as befitting the reverence for the beings addressed; many even went so far as to turn their faces away from the dread being to whom they prayed. After the departure of the men the two planting gods silently gathered up the feathered prayer offerings offered them, and departed.

The supernatural being called Masauu, also known as Eototo, was the chief cult being of the Fire people who migrated into the Hopi country, according to legends, from the East in prehistoric times. They formerly lived at a pueblo, now in ruins, three miles east of Walpi, called Sikyatki. A quarrel arose between Walpi and the inhabitants of Sikyatki, sometime before 1540, which eventually led to the overthrow of the latter pueblo, whose people were incorporated in the former. Their cultus supernatural, Masauu, transferred to the Hopi pantheon, is still from time to time personated by descendants of the ill-fated Sikyatki, now fused with other Walpi clans.

Digitized by Google Original from HARVARD UNIVERSITY

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

GRAVITY.—*Investigations of gravity and isostasy.* WILLIAM BOWIE. U. S. Coast and Geodetic Survey, Special Publication No. 40. Pp. 196, with 18 illustrations. 1917.

For a number of years the U. S. Coast and Geodetic Survey has been carrying on geodetic investigations of isostasy with special reference to the effect of isostatic compensation upon the deflection from the vertical and upon the intensity of gravity. Four reports on these investigations have appeared previously. The first one was in 1909 and the last one in 1912.

The present report has as its main features: (1) The observed value of the intensity of gravity at the stations in the United States, Canada, India, and Europe, and at a few scattered stations. (2) Discussions of the relations between the gravity anomalies and the topography, the large areas of erosion and deposition, the geological formation as indicated by the surface rock, and the elevation of the station. (3) So-called regional versus the local distribution of the isostatic compensation. (4) The determination of a gravity equation and of the earth's flattening and the depth of compensation upon each of several assumptions. (5) Summaries of the results of the field observations with the pendulums, and descriptions of the gravity stations. (6) Illustrations, in the pocket at the back of the volume, showing graphically much data resulting from the investigation.

The results of the investigation may be summarized briefly as follows:

1. The most probable depth of compensation derived from gravity observations alone is 95 kilometers. As the author believes that the best value determined by Hayford from deflection data is 97 kilometers and that each of these two values should have equal weight, the resulting best value from all geodetic data is 96 kilometers.

Digitized by Google Original from HARVARD UNIVERSITY

2. In the United States there was found a decided relation between the sign of the gravity anomalies and the coast, but there was not found any apparent relation between the anomalies and any other class of topography.

3. In the United States there was found a decided relation between the gravity anomalies and the Pre-Cambrian geologic formation. In both the United States and in India there was found a decided relation between the gravity anomalies and the Cenozoic formation. No relation between the gravity anomalies and the geologic formations was found in Canada.

4. It was found from certain computations and investigations that the local distribution of compensation of the topographic feature is in general nearer the truth than regional distribution of the compensation out to a distance from the station of 167 kilometers. It was not proven whether local distribution is more probable than a regional distribution out to a distance of 59 kilometers from the station.

5. The best formula, resulting from this investigation, by which theoretical gravity may be computed for any latitude at sea level was based upon 348 stations; it is

$\gamma_0 = 978.039\ (1 + 0.005294\ \sin^2 \phi - 0.000007\ \sin^2 2\ \phi)$ in which γ_0 is the value of gravity sought and ϕ is the latitude of the station.

6. From the constants of the above gravity formula, was derived the value of 297.4 for the reciprocal of the flattening of the earth. This value of the flattening is very close to other values recently derived from gravity data in the United States and elsewhere.

7. The cause of the greater part of the anomalies is believed by the author to be in general the deviation from normal in the densities in the outer portion of the earth's material and probably not far below sea level.

The titles of a number of articles dealing with isostasy or related subjects are given. W. B.

PHYSICS.—*A specific gravity balance for gases.* J. D. Edwards. Bureau of Standards Technologic Paper No. 89. Pp. 20. 1917.

The need of an accurate method for determining gas densities has been especially urgent in the natural gas industry. To supply this need the apparatus described in this paper was designed. The balance is enclosed in a gas tight chamber and consists of a beam which is supported on 2 needle points, and which carries on one end a relatively large globe and on the other a small counterweight. The gas to be

Digitized by Google Original from HARVARD UNIVERSITY

studied is introduced into the balance case and its pressure is changed until the beam balances. The density is computed from the initial and the final pressures. The balance is standardized by similar observations made with the case filled with air. J. D. H.

CHEMISTRY.—*Experiments in the destruction of fly larvae in horse manure.* F. C. Cook, R. H. Hutchison, and F. M. Scales. U. S. Department of Agriculture Bulletins 118 and 245. 1914 and 1915.

Experiments during 1915 in the destruction of fly larvae in horse manure. F. C. Cook and R. H. Hutchison. U. S. Department of Agriculture Bulletin 408. 1916.

These three bulletins cover experiments extending over three years searching for satisfactory larvicides for fly larvae to be applied to fresh horse manure (the principal breeding place of the house fly) which would be without extremely toxic properties and without injurious action on the fertilizing value of the manure. The study involved entomological, bacteriological, and chemical investigations.

Over 50 substances have been tested of which three have been found effective and practicable. Some were excluded because of their extreme toxicity, such as potassium cyanide. The three that are recommended are borax, hellebore, and calcium cyanamid mixtures with acid phosphate.

Borax in large amounts injures plant growth, hence should be applied only to manure that is not to be used as a fertilizer.

Powdered hellebore (*Veratrum album* and *V. viride*) applied as a solution is an effective larvicide and, because it is decomposed in the course of the fermentation, does not affect the fertilizing value of the manure even when excessive quantities are used.

Calcium cyanamid mixed with acid phosphate and kainit are effective and, if enough acid phosphate has been added to give an acid reaction, the nitrogen and ammonia of the manure will be retained. The mixture is an advantage in that it adds to the manure nitrogen, potash, and phosphoric acid. F. C. C.

METALLOGRAPHY.—*The structure of the coating on tinned sheet copper in relation to a curious case of corrosion of this material.* Paul D. Merica. Bureau of Standards Technologic Paper No. 90. Pp. 18. 1917.

The attention of the author has been directed to a case of local corrosion, or pitting, in tinned sheet copper roofing. The pits occur in

Digitized by Google Original from HARVARD UNIVERSITY

general along the lines of surface scratches and are apparently unrelated to the service conditions, and to the direction of rolling of the sheet. They appeared some eight or ten years after the completion of the roof. The tin coating on copper consists of at least three layers; viz., a thin layer of Cu_3Sn immediately next to the copper, than a layer of Heycock and Neville's constituent H, containing about 60 per cent by weight of tin, and finally, a layer of the eutectic of tin and copper, in which most probably is found any lead that may have been present in the tinning mixture. The constituents of these intermediate alloy layers are more electronegative than either the tin or the copper. Consequently, when the copper becomes exposed, as at the bottom of scratches on the surface, it forms together with the alloy layer a galvanic couple, electrolytic action sets in, and the copper at these points is corroded, forming the pits mentioned. P. D. M.

GEOLOGY.—*Relations of the Embar and Chugwater formations in central Wyoming.* D. DALE CONDIT. U. S. Geological Survey Professional Paper 98–O. Pp. 263–270, with 3 plates and 2 figures. 1916.

The Embar formation of central Wyoming, which lies between the Tensleep sandstone and the Chugwater formation, comprises several distinct facies, each of which is considered in detail, and some of the formational boundaries in the Bighorn Mountain region are redefined. In connection with the description of the gypsum and associated strata it is suggested that possibly conditions were favorable for accumulation of salt beds also. The chance of finding such deposits down the dip below the surface is believed to be sufficient to merit further investigation. R. W. S.

BOTANY.—*Maxonia, a new genus of Tropical American ferns.* CARL CHRISTENSEN. Smithsonian Miscellaneous Collections, **66**[9]: 1–4. 1916.

The type and sole species of this new genus, *M. apiifolia*, is a rather rare polypodiaceous fern of Jamaica and Cuba, described by Swartz in 1801 under Dicksonia, and since variously referred to Dryopteris (or Nephrodium) and Polystichum. From Dryopteris, in which it was last placed as a special subgenus by Maxon in 1909, it differs in the unique morphology and development of the indusium, as also in its strongly dimorphic leaves and peculiar rope-like rhizome. The last two characters recall Polybotrya, between which genus and a small subgroup of Dryopteris species it is somewhat intermediate. A subspecies, *M. apiifolia dualis*, occurs in Guatemala. P. C. S.

Digitized by Google Original from HARVARD UNIVERSITY

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 783rd meeting was held at the Cosmos Club, February 3, 1917. Vice President Burgess in the chair; 61 persons present. The minutes of the 782nd meeting were read in abstract and approved.

A letter signed by several members of the society, calling attention to the recently organized American Metric Association, was read.

Mr. Arthur W. Clime, introduced by Mr. Alexander Graham Bell, presented a communication on *Photoelectric radiophonic experiments.*

Mr. Bell, in introducing Mr. Clime, spoke of the history of selenium. He referred to the remarkable property possessed by crystalline selenium of having its electrical resistance affected by light; and of the utilization of that property in the construction of the photophone. He also referred to the discovery made by the late Prof. W. G. Adams, of King's College, England, that light produced an electromotive force in crystalline selenium. Mr. Bell had suggested to Mr. Clime that this opened up a new field for scientific investigation and recommended him to follow out the experiments of Prof. Adams by applying the results to radiophonic researches. He had also pointed out to Mr. Clime that the remarkable properties of carbon in radiophonic work would well bear exploration.

Mr. Clime then exhibited some of the radiophonic apparatus he has constructed, and spoke of the results that had been obtained. He showed a selenium cell which, when exposed to an intermittent beam of light, caused a telephone connected with it to emit a musical sound even when there was no battery in the circuit. The result he claimed was due to an electromotive force produced in the crystalline selenium by the action of light. He also showed a cell in which the selenium had been replaced by lampblack. So long as there was a voltaic battery in the circuit the telephone responded well when the lampblack surface was illuminated by an interrupted beam of light, but he was unable to detect any audible effect when the battery was removed. A cell in which a mixture of selenium and lampblack was employed was then exhibited. In this case the sonorous responses of the telephone were very loud even when no battery was used. The musical tone was clearly perceived when the telephone was held at a distance of several inches from the ear. On account of the magnitude of the sound produced by the selenium-carbon mixture, Mr. Clime predicted the possibility of producing, by the action of sunlight, an electromotive force of sufficient power to be of economic value.

Digitized by Google

Original from
HARVARD UNIVERSITY

Discussion. The paper was discussed by Messrs. ABBOT, BAUER, and WEED. Mr. SOSMAN inquired as to the nature of the effect of adding carbon. Mr. Clime stated that the increase in response seemed out of all proportion to the increase in absorption due to blackening the surface. Mr. BRIGGS asked about a lack of symmetry in the illuminated system, and Mr. SWANN spoke of observing small electromotive forces in very thin films of platinum illuminated by a beam of light not perpendicular to the surface. The chair expressed the thanks of the society to Mr. Clime for his interesting communication.

Mr. W. W. COBLENTZ then gave a paper on *Characteristics and comparative sensitiveness of various types of radiometers.*

The various types of radiometers were divided into three groups.

Group I includes radiometers which are nonselective in their response to stimuli of radiant energy of all wave lengths. In these instruments the radiant energy is absorbed and converted into heat. They include the Nichols radiometer, the thermocouple, the Boys radiomicrometer, and the Langley bolometer. In all these instruments the response is proportional to the stimulus, and they are well adapted for quantitative work.

Group II includes substances which have the property of decreasing in electrical resistance when exposed to radiant energy of short wavelengths, especially visible and ultraviolet rays. The phenomenon depends entirely upon the wave-length of the light stimulus. Many substances are "light-sensitive," e.g., copper oxide, sulphides of antimony and silver, and crystalline selenium. The latter has been the most extensively investigated. Its sensitivity depends upon heat treatment, and varies with the intensity and wave-length of the light stimulus. After exposure to light for a few seconds, it requires a long time to recover its normal ("dark") resistance. It is not adapted to quantitative work.

Group III includes the photo-electric cells, substances which, when charged to a negative potential, lose their charge when exposed to light; especially violet and ultra-violet rays. This emission of electrons is a surface phenomenon, easily disturbed by oxidation of the surface. The photo-electric cells investigated consisted of potassium and rubidium. It was found that the response (galvanometer deflection) was not proportional to the intensity of the stimulus, but, differing from the selenium cell, this lack of proportionality of response does not appear to depend upon the wave-length of the exciting light. In 1907 Angström described a new method for studying solar radiation. By covering his pyrheliometer with a blue glass he was able to study atmospheric diffusion of solar radiation independently of the water vapor present. He obtained some very interesting data on the temporary variations in the solar constant. In view of the fact that the potassium photoelectric cell has its maximum sensitivity in the violet, the speaker tried it as a pyrheliometer. It was found entirely too sensitive (on only 2 volts) to be used with an insensitive d'Arsonval galvanometer. Using a higher voltage and a milliammeter, the

Digitized by Google Original from HARVARD UNIVERSITY

current released when the cell was exposed (through blue glass to reduce the intensity of the sun-light) was sufficient to overheat the wires and crack the glass cell. This investigation should be continued, using a less sensitive photoelectric substance.

In certain spectral regions the sensitivity of the selective-radiometers is far greater than that of the non-selective instruments. The sensitivity of the selective instruments seems spread in the non-selective radiometer over the whole spectrum, with a corresponding reduction to a uniform and much lower value. From published data it appears that a single crystal of selenium, 1 sq. mm. in area, is 100 times as sensitive as the best selenium cell. In connection with a 36 inch telescope such a crystal receiver could detect a candle at a distance of 350 miles. The photoelectric cell is probably even more sensitive than the selenium cell. However, these instruments are very insensitive in comparison with the eye, which responds to light having an intensity of less than 1×10^{-9} ergs.

Discussion. Mr. ABBOT spoke of some radiometers of very high sensitivity in which the alignment of small magnetic needles was changed by the thermal expansion of the parts holding them. Mr. SWANN spoke of obtaining readings by placing a Peltier junction beside a thermocouple and maintaining the thermocouple at a constant temperature by the Peltier effect. Mr. ABBOT spoke of increasing the sensitivity by cooling the apparatus in liquid air. Mr. COBLENTZ stated that temperature differences in the surroundings make it very difficult to get consistent results.

DONALD H. SWEET, *Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 564th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Saturday, January 27, 1917; called to order at 8 p.m. by President HAY; 45 persons present.

Under the heading of brief notes, Messrs. W. L. MCATEE and A. WETMORE made remarks on certain misconceptions as to the notes of some common species of birds and as to a theory of the migration of birds.

Under the heading exhibition of specimens, DR. O. P. HAY showed a metacarpal of a horse with well developed lateral metacarpals, and three fused metacarpals of a cow each with well developed digits.

DR. L. O. HOWARD commented on an enthusiastic antimosquito convention which he had lately attended in New Jersey.

The regular program consisted of two communications:

H. M. SMITH: *Exploitation of neglected aquatic resources.* Dr. Smith called attention to many forms of fishes not used as food by the American public, but which are of pleasing taste and of good food value. Many of these have long been used for food by Europeans especially about the North Sea. He gave a brief résumé of the discovery, disappearance, and rediscovery of the tilefish and of its successful introduc-

Digitized by Google Original from HARVARD UNIVERSITY

tion to the consumer through exploitation by the Bureau of Fisheries. He then described the dogfish and its habits destructive to other fish and the losses caused by it to fishermen. He told of the efforts now being made by the Bureau of Fisheries to market the dogfish as a food. Under the name of grayfish it is now being successfully canned and marketed by some of the New England fisheries and, during the winter months when salmon are unattainable, by some of the salmon canneries on the Pacific coast. The canned meat not only constitutes one of the cheapest forms of protein now available, but the livers of the dog-fish yield a valuable oil; the oviducts, eggs; and the skin a leather which has many possibilities. Discussion by Messrs. AMES, BEAN, and DOOLITTLE.

W. L. MCATEE: *Showers of organic matter.* Under this heading Mr. McAtee gave a review of the various apocryphal and authentic instances in which hay, grain, various insects, encysted animalcules, worms, frogs, toads, fishes, and birds had fallen from the sky. The explanation was offered that the objects had been carried aloft by violent currents of air.

The 565th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Saturday, February 10, 1917; called to order at 8 p.m. by President HAY; 30 persons present.

Two formal communications were presented:

H. F. TAYLOR: *A mortality of fishes on the west coast of Florida.* During the months of October and November, 1916, by some obscure cause, vast numbers of fishes were killed in the region mentioned. It appears to be a recurrence of the phenomenon observed in 1844, 1854, 1878, 1880, 1882, 1883 and 1908. Of the dead fishes 63 species, representing 37 families, were identified. The animals killed were confined, with the exception of king crabs, sea urchins, and sponges, to the class *Pisces*. Various suggested causes were examined; foul Everglade water, diseases, and volcanic eruptions are inadequate explanations. Evidence at hand seems rather to show that the cause of mortality was the release of occluded bottom gases by small seismic disturbances, or possibly by abnormally large numbers of *Peridinii*. Mr. Taylor's paper was illustrated by lantern slide views of the region involved and of strips of shore showing the large numbers of stricken fishes. His paper was discussed by Messrs. HAY, BARTSCH, GOLDMAN, RADCLIFFE, and others.

PAUL BARTSCH: *Changes in the avifauna about Burlington, Iowa, 1885 to 1917.* From 1885 to 1893 Dr. Bartsch was resident of Burlington and an enthusiastic bird collector. In the ideal conditions found for birds at Burlington he had recorded 275 species. Since 1893 he has been a sporadic visitor to Burlington but has always retained his interest in the local avifauna. Passenger pigeons, Carolina parakeets, whooping and sandhill cranes, and trumpeter swans were found about Burlington, but are no longer seen. The same is true of the Mississippi kite, the swallow-tailed kite, wild turkey, and

Digitized by Google Original from HARVARD UNIVERSITY

prairie chickens, the latter in times past having been shot from the speaker's porch. The prothonotary warbler, once common, appears to have gone northward. New birds now found at Burlington have come from the west, such as western meadowlark and red-shafted flicker. Other newcomers are the tufted tit and Carolina wren. Many of these changes are due to human agencies, some are unexplainable. Dr. Bartsch's paper was discussed by Messrs. HAY, MCATEE, WILCOX, GOLDMAN, JACKSON, and others.

M. W. LYON, JR., *Recording Secretary.*

THE BOTANICAL SOCIETY OF WASHINGTON

The 117th regular meeting of the Society was held in the Assembly Hall of the Cosmos Club at 8 p.m., January 2, 1917, President T. H. KEARNEY presiding. Mr. C. W. WARBURTON was elected to membership.

Under Brief Notes and Reviews of Literature, Mr. W. T. SWINGLE called attention to a recent trip by Prof. E. D. Merrill of the Philippine Bureau of Science, to the vicinity of Canton, China, where 3000 botanical specimens were secured.

The regular program was devoted to the subject of Plant Introduction under which the following papers were presented:

The need of more foreign agricultural exploration. (Illustrated): DAVID FAIRCHILD. Attention was called to the need of more foreign agricultural exploration and to the fact that only a comparatively small amount of money had been expended in such work. The amount had seldom, if ever, exceeded $18,000 in any one year, and for the most part the expense had been much lower. The most successful type of agricultural exploration has been carried on by men who are interested in particular lines of agricultural work. Among those who have been called into the exploration work temporarily are Messrs. Kearney, Carleton, Hansen, Swingle, Cook, Collins, Oliver, Aaronsohn, Meyer, Rolfs, Bessey, Knapp, Mason, Scofield, Shamel, Dorsett, Popenoe, Young, Lake, Bolley, Shear, Tracy, and Fairchild. Attention was also called to the need of studying the methods of agricultural production in foreign countries, to some of the more important recent introductions, and to the difficulty in getting people to adopt new foods.

The wild relatives of our crop plants; their value in breeding; how to secure them. (Illustrated): WALTER T. SWINGLE. The importance of the wild relatives of our cultivated plants in effective breeding for such desirable qualities as hardiness, earliness or lateness of blooming or of ripening, disease resistance, extra vigor, etc. was discussed. Frequently these wild relatives were found to be inconspicuous plants quite unlike the cultivated forms in appearance and were often native in remote localities. The Australian desert Kumquat, *Eremocitrus glauca*, for example, was originally described under the genus *Triphasia* and afterwards transferred to the genus *Atalantia*. In neither of these

Digitized by Google Original from HARVARD UNIVERSITY

genera was it properly placed, since it is closely related to true citrous fruits and will hybridize with the cultivated forms. Not cursory inspection of botanical literature, but protracted critical study of the botanical relationships, was necessary to make plain the desirability of the introduction of this species for the successful breeding of hardy and drouth-resistant citrous fruits. Plants not so closely related to the cultivated forms have been found useful stocks upon which to graft cultivated varieties. A properly digested taxonomic knowledge of the wild relatives of our cultivated plants was found to be indispensable as a foundation for all efficient plant introduction and plant breeding.

The introduction of foreign plant diseases: R. KENT BEATTIE. American agriculture has been based largely on introduced plants. Only twelve of the two hundred and forty-seven species of cultivated plants studied by De Candolle in his *Origin of Cultivated Plants* are clearly indigenous to the United States. Diseases of American economic plants may be separated into two groups: (1) Those which have passed from native plants to the introduced hosts, such as pear blight; (2) Those which have been introduced, such as citrous canker and the chestnut bark disease. Plant disease may be introduced in three ways: (1) The diseased crop plant may be imported for commercial use; (2) The diseased crop plant may be imported for scientific purposes; (3) The spores of the disease-producing organism may be brought in on plants not affected by the disease.

Commercial plant introduction, except field crops and florist stock, has been under a system of permit and inspection. In most states, however, the inspectors were trained as entomologists rather than pathologists, and there has been little restriction on the commercial importation of fungus plant diseases, except in the case of specifically quarantined crops. Material imported by the U. S. Department of Agriculture has undergone rigid inspection and plants which show symptoms of disease or arouse suspicion have been treated or grown under restraint until danger was passed. During the year 1916 the Pathological Inpectors of the Federal Horticultural Board while examining the material imported by the U. S. Department of Agriculture found one hundred and sixty-three hosts affected with disease and determined one hundred and fifty-seven diseases on these hosts.

The protection and propagation of plant introductions: B. T. GALLOWAY. The rapid change in public sentiment in the matter of plant sanitation and plant hygiene and the need for a constructive policy in the matter of adequately protecting our crop plants, and at the same time not closing the doors to the development of new crop industries through the introduction of plant immigrants, was discussed.

The Office of Foreign Seed and Plant Introduction in the Department of Agriculture has received seeds and plants from all over the world. These seeds and plants were grown, propagated, and tested at four outlying stations. It has also acted as the agent for handling seeds and plants from foreign countries for other branches of the Department, for the experiment stations, and for many private and pro-

Digitized by Google Original from HARVARD UNIVERSITY

fessional experimenters throughout the country. It has recognized the dangers to our important crop industries and has endeavored to take such steps as, in the light of our present knowledge, will insure that nothing but plants free from parasitic enemies and transmissible diseases are distributed.

The practical questions now confronting the office are as follows: (1) The organization, development, and equipment of a central plant and seed receiving station where plant introductions and plant materials of all kinds may be received, inspected, treated, and held if necessary, under conditions that will safeguard the country, and at the same time not prove to be a bar to a safe and constructive development of new plant industries; (2) The discovery and application of methods of treating seeds and plants, cuttings, buds, bulbs, etc., in such fashion as will free them from parasitic enemies and transmissible diseases, and at the same time not injure them or completely destroy them; (3) The discovery and application of improved methods of reproducing plants by seeds and vegetative parts in such manner that they will be free from parasitic enemies and transmissible diseases; (4) The conducting of field tests and trials for the purpose of determining the healthfulness of new or promising plant immigrants, and their suitability for general distribution; (5) The great need of further knowledge of plant propagation and plant and soil sterilization in order to provide methods which are less empirical than those in use at the present time.

H. L. SHANTZ, *Corresponding Secretary.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 506th meeting of the Society was held in the Lecture Hall of the Public Library, Tuesday evening, February 6, 1917, at 8 o'clock.

Dr. J. WALTER FEWKES, of the Bureau of American Ethnology, read a paper on *Prehistoric ruins of the Mesa Verde National Park.* This communication was mainly taken up by an outline of the work accomplished by him, in the summer of 1916, under direction of the Bureau of American Ethnology, at the request of the Department of the Interior. After a brief introduction on the situation and physical features of the Park and a short account of archeological work already accomplished, the speaker described in detail the uncovering and repair of one of the large pueblo-like buildings of the Mummy Lake group, situated on the Government road, 4½ miles from the ruin known as Spruce-tree House.

The mound excavated is one of the largest of the group, and when the work began gave no indication of the form, size, and architectural features of the building it covered. After three months' work there was brought to light a rectangular structure, 113 feet long by 100 feet wide, three stories high, with an enclosed court on the south side. The ground plan showed the existence of four circular, ceremonial rooms compactly embedded in fifty rectangular enclosures which were for-

Digitized by Google Original from HARVARD UNIVERSITY

merly used for secular purposes. The remarkable feature of this ruin is the large size of one of the circular rooms, situated in the center of a compact group of chambers. From the wide southerly outlook this ruin has received the name, Far View House. It is a pueblo habitation; the first of its type ever brought to light on the plateau. The ruin was repaired, the tops of the kivas being treated with Portland cement to protect them from the elements.

After describing the various architectural details of the building Dr. Fewkes passed to a consideration of what he termed the morphology of the structure, or the comparison of it with other types, especially the cliff dwellings of the Mesa Verde. He declared that it is a new type of ruin for that region, and that there are evidences of many other examples of the same general character now indicated by mounds; we may say that formerly there were as many members of this type on the Park as cliff dwellings in the caves of the canyons. He considered in detail some of the arguments bearing on the relative age of buildings like Far View House, and the cliff dwellings, and came to the conclusion that the former were the more recent, and evolved from the habitations in cliffs.

Considerable time was devoted to a discussion and comparison of the so-called kiva or sacred room. He held that this chamber should be made the basis of classification of pueblo ruins, and that it was represented by the tower found widely distributed in Utah and adjacent regions of Colorado. He pointed out the wide-spread custom of dual styles of buildings among primitive races, one type being devoted to religious purposes, the other to habitations. He claimed that the former are always better constructed than the latter. He regarded the tower as a religious building and thought that the people who used it lived in dugouts or temporary habitations that have disappeared. In the earliest times these two types were separated, but in later stages in the evolution of buildings they became united, and habitations were constructed around the bases of the towers. Later in the course of development the central original building lost its tower-like form and became the circular kiva. Several similar architectural units, by union, formed a pueblo.

Dr. Fewkes pointed out that the great morphological similarity between Far View House and the pueblos with central kivas and towers, many miles away, had an important bearing on the distribution or diffusion of pueblo culture. He regarded the San Juan region as the nucleus from which the pueblos south and west originated, thus substantiating by archaeological evidence the legendary traditions of the inhabited and much modified historic pueblos. He claimed that there were two nuclei of distribution of house builders in the southwest, each arising in regions physiographically and climatically distinct, each possessed of different materials available for architectural advancement. One arose in the Gila Valley, the other in the San Juan; the former spread toward the north, the latter to the south. Both nuclei were extinct before the historic epoch. What remained, or

Digitized by Google Original from HARVARD UNIVERSITY

that which we now know as the culture of living descendants, is the product of acculturation, due to cultural contacts in this expansion. History can afford, therefore, only an imperfect picture. We must rely on archeology, mainly architectural, and ceramic remains, supplemented by ethnology, to discover the nature of the culture of these two original nuclei.

In a discussion of their distribution the speaker showed numerous illustrations of the prehistoric kivas, called towers, situtated in Hill Canyon, near Ouray, Utah. To these he gave the name, suggested by their site, Mushroom Rock ruins. Their more striking peculiarity is their position on the tops of inverted cones, or mushroom-like formations of rock, produced by the enormous erosion evident in the region where they occur. He said that this form of ruins was not morphologically a different type from towers, but their site was so unusual that it was convenient to designate them by this name.

While the important question of the antiquity of the cliff dwellings has not been satisfactorily answered by the observation made at Far View House, progress is being made in the accumulation of significant data bearing upon it. As long as this question remains unanswered the archeologist has plenty of research before him for many more years of field work in the Southwest.

The communication was illustrated with lantern slides.

The 507th meeting of the Society was held in room 44 of the New National Museum, February 20 at 4 p.m. The speaker of the afternoon was Dr. I. M. Casanowicz of the New National Museum, who presented a paper on *The fish in cult, myth, and symbol.*

Dr. Casanowicz said, "The fish, as the inhabitant of the mysterious, indestructible, never-resting water, early impressed man deeply, and was considered by him as the genius and representative of the life-producing element. Traces of the veneration of the fish, sometimes revealed in taboos, are found everywhere in ancient times and still exist in various parts of the world." An important center of ichthyolatry in antiquity, according to the testimony of classical writers, was Syria where a fish goddess under the name of Derketo-Atargatios was worshiped as a phase of the great Semitic mother goddess Astarte, being regarded as a personification of the fructifying power of the water. Reminiscences of this cult still survive in the cherishing of sacred inviolate fishes in some places near mosques.

Tales of the fish as a medium of transformation and incarnation of spirits and ghosts are met with among various nations, and in later times the fish seems to have been, next to the bird, a symbol of the departed human soul. The fish as carrier of man across the water was illustrated by the story of Arion and the dolphin as told by Herodotus, and by the Biblical narrative contained in the book of Jonah. Parallel narratives of a man being swallowed by a sea monster were quoted from Greek, Polynesian, and Cherokee lore.

The belief in the magical and apotropaic properties of the fish was

Digitized by Google Original from HARVARD UNIVERSITY

also found to be widespread. The fish was generally considered as a being of good omen, benevolent and beneficient toward man, and by reason of its own great fertility it was a symbol of increase and abundance. Various regions had their favorite species of fish which were endowed with supernatural qualities. Thus among the classical nations the dolphin was termed the "saviour fish" (piscis salvator). In the Far East (China and Japan) the carp was the fish of good omen, while among the ancient Irish the salmon was the "fish of wisdom," the mere sight of which brought healing.

Dr. Swanton introduced the discussion of the paper by calling attention to the fact that migrations of Indians were influenced largely by the food supply. Thus many tribes of Indians followed the rivers and streams because of the presence of fish. Dr. Michelson mentioned the legend of a miraculous fish among the Delaware Indians, and also noted a similarity between the ancient beliefs concerning the fish and those held by the North American Indians. Mr. E. T. Williams spoke on the use of the fish in Japan and China, the latter country considering it martial in character because of its fearlessness in proceeding against the current of a stream, and also because of its scales, which suggest a coat of mail.

Frances Densmore, *Secretary.*

Digitized by Google Original from HARVARD UNIVERSITY

ANNOUNCEMENT OF MEETINGS OF THE ACADEMY AND AFFILIATED SOCIETIES[1]

LECTURES ON HEREDITY

A series of lectures on Heredity will be presented before the Washington Academy of Sciences during March and April, 1917. The first of these addresses entitled *Observed changes in hereditary characters in relation to evolution*, by Prof. H. S. Jennings, Johns Hopkins University, Baltimore, will be presented on Thursday evening, March 15th, at 8.15 o'clock, in the Assembly Room of the Cosmos Club, H Street and Madison Place.

Other addresses in the series will be given on the following tentative dates:

March 29: Dr. Oscar Riddle: *The control of the sex ratio.*
April 13: Prof. W. E. Castle: *The rôle of selection in heredity.*
April 26: Dr. Alexander Graham Bell: *The bearing of heredity on human affairs.*

Notices will be sent out before each meeting

Monday, March 19: The Anthropological Society, at the Public Library, at 8 p.m. Program:

Fay-Cooper Cole, Assistant Curator in the department of anthropology at the Field Museum of Natural History: *The pagan tribes of the Philippines.* (Illustrated.)

Saturday, March 24: The Biological Society, at the Cosmos Club, at 8 p.m.

Wednesday, March 28: The Geological Society, at the Cosmos Club, at 8 p.m.

Saturday, March 31: The Philosophical Society, at the Cosmos Club, at 8.15 p.m. Program:

F. J. Bates and F. P. Phelps: *Rotation of the plane of polarization by quartz and iron at high temperatures.* 30 minutes.
F. E. Wright: *Application of polarized light to the study of opaque substances.* 20 minutes.
P. V. Wells: *A standard of turbidity.* 15 minutes.

Tuesday, April 3: The Botanical Society, at the Cosmos Club, at 8 p.m.

[1] The programs of the meetings of the affiliated societies will appear on this page if sent to the editors by the thirteenth and twenty-seventh day of each month.

Digitized by Google
Original from
HARVARD UNIVERSITY

CONTENTS

Original Papers

Page

Electrochemistry.—The electrometric titration of zinc with ferrocyanide. F. Russell v. Bichowsky 141

Mineralogy.—Neodymium as the cause of the red-violet color in certain minerals. Edgar T. Wherry 143

Genetics.—A correlation between endosperm color and albinism in maize. J. H. Kempton 146

Ethnology.—An initiation at Hano in Hopiland, Arizona. J. Walter Fewkes 149

Abstracts

Gravity 159
Physics 160
Chemistry 161
Metallography 161
Geology 162
Botany 162

Proceedings

The Philosophical Society of Washington 163
The Biological Society of Washington 165
The Botanical Society of Washington 167
The Anthropological Society of Washington 169

Digitized by Google

Original from
HARVARD UNIVERSITY

I. SOC. 120.146. 230.15

LIBRARY
PEABODY MUSEUM
RECEIVED
NOV 3 1955

VOL. VII — APRIL 4, 1917 — No. 7

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

BOARD OF EDITORS

N. ERNEST DORSEY — BUREAU OF STANDARDS
ADOLPH KNOPF — GEOLOGICAL SURVEY
A. S. HITCHCOCK — BUREAU OF PLANT INDUSTRY

PUBLISHED SEMI-MONTHLY
EXCEPT IN JULY, AUGUST, AND SEPTEMBER, WHEN MONTHLY

BY THE

WASHINGTON ACADEMY OF SCIENCES

OFFICE OF PUBLICATION
WILLIAMS & WILKINS COMPANY
BALTIMORE, MD.

Entered as second-class matter July 14, 1911, at the post office at Baltimore, Maryland, under the Act of July 16, 1894

Digitized by Google — Original from HARVARD UNIVERSITY

Journal of the Washington Academy of Sciences

This JOURNAL, the official organ of the Washington Academy of Sciences, aims to present a brief record of current scientific work in Washington. To this end it publishes: (1) short original papers, written or communicated by members of the Academy; (2) a complete list of references to current scientific articles published in or emanating from Washington; (3) short abstracts of certain of these articles; (4) proceedings and programs of meetings of the Academy and affiliated Societies; (5) notes of events connected with the scientific life of Washington. The JOURNAL is issued semi-monthly, on the fourth and nineteenth of each month, except during the summer when it appears on the nineteenth only. Volumes correspond to calendar years. Prompt publication is an essential feature; a manuscript reaching the editors on the second or the seventeenth of the month will ordinarily appear, on request from the author, in the next issue of the JOURNAL.

Manuscripts may be sent to any member of the Board of Editors; they should be clearly typewritten and in suitable form for printing without essential changes. The editors cannot undertake to do more than correct obvious minor errors. References should appear only as footnotes and should include year of publication.

Illustrations will be used only when necessary and will be confined to text figures or diagrams of simple character. The editors, at their discretion, may call upon an author to defray the cost of his illustrations, although no charge will be made for printing from a suitable cut supplied with the manuscript.

Proof.—In order to facilitate prompt publication no proof will be sent to authors unless requested. It is urged that manuscript be submitted in final form; the editors will exercise due care in seeing that copy is followed.

Authors' Copies and Reprints.—On request the author of an original article will receive gratis ten copies of the number containing his contribution and as many additional copies as he may desire at five cents each. Reprints will be furnished at the following schedule of prices:

	4 pp.	8 pp.	12 pp.	16 pp.
50 copies	$1.08	$1.95	$2.93	$3.80
100 copies	1.30	2.40	3.60	4.70
Additional copies, per 100	.45	.90	1.35	1.70

Covers bearing the name of the author and title of the article, with inclusive pagination and date of issue, will be $2.00 for the first 100. Additional covers $1.00 per 100.

As an author may not see proof, his request for extra copies or reprints should invariably be attached to the first page of his manuscript.

The rate of Subscription per volume is	$6.00*
Semi-monthly numbers	.25
Monthly numbers	.50

Remittances should be made payable to "Washington Academy of Sciences," and addressed to the Treasurer, William Bowie, Coast and Geodetic Survey, Washington, D. C., to Williams & Wilkins Company, 2419-2421 Greenmount Ave., Baltimore, Md., or to the European Agents.

European Agents: William Wesley & Son, 28 Essex St., Strand, London, and Mayer and Müller, Prinz Louis-Ferdinand Str., Berlin.

Exchanges.—The JOURNAL does not exchange with other publications.

Missing Numbers will be replaced without charge, provided that claim is made within thirty days after date of the following issue.

* Volume I, however, from July 19, 1911 to December 19, 1911, will be sent for $3.00. Special rates are given to members of scientific societies affiliated with the Academy.

THE WAVERLY PRESS
BALTIMORE, U. S. A.

Digitized by Google
Original from
HARVARD UNIVERSITY

JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. VII APRIL 4, 1917 No. 7

MATHEMATICS.—*Note on multiple algebra: The reduction of real dyadics and the classification of real homogeneous strains.* EDWIN BIDWELL WILSON, Massachusetts Institute of Technology. (Communicated by Arthur L. Day.)

1. About ten years ago I printed an account of some parts of Gibbs's course of lectures on multiple algebra.[1] In the classification, or reduction to a canonical form, which was there established for dyadics no attention was paid to distinctions between real and imaginary. I had in mind at that time to give the extension of Gibbs's work in Vector Analysis[2] needed to obtain the reduction of real dyadics to type forms, but did not publish my results. I desire now to show how the algebraic methods used by Gibbs to find the general classification lend themselves immediately to the further subdivision relative to reality.

The sort of dyadic under consideration is (p. 11):[3]

$$\Phi = \alpha \mid \alpha^0 + \beta \mid \beta^0 + \ . \ . \ . \ ,$$

where the antecedents α, β, . . . are ordinary vectors and the consequents α^0, β^0, . . . are $(n-1)$-dimensional vectors in n-dimensional space. (The vertical bars serve as separators and

[1] WILSON, EDWIN B. *On the theory of double products and strains in hyperspace.* Trans. Conn. Acad. Arts Sci., **14**: 1–57. 1908.

[2] GIBBS-WILSON. Vector Analysis, pp. 356–367.

[3] The page numbers in the text refer to the memoir cited in Note 1. I here use an upper zero instead of a dash over a letter to represent an $(n-1)$-vector.

Digitized by Google Original from HARVARD UNIVERSITY

have no connection with Grassmann's Ergänzung.) The only kind of multiplication used in the work is the (progressive or regressive, single or multiple) combinatory product. That means that we work with the affine, not with the metric, group of linear transformations with one point fixed, i. e., with homogeneous strains.

2. The essential steps in the reduction of a dyadic are these:

(*a*) As there are only n^2 independent dyads, any dyadic must satisfy a polynomial equation, with numerical coefficients, of degree not exceeding n^2. Hence any dyadic satisfies an equation

$$\Lambda\,(\Phi) = \Phi^m + c_1\,\Phi^{m-1} + \;.\;.\;.\; + c_{m-1}\,\Phi + c_m\,I = 0$$

of *lowest* degree, I being the idemfactor. This equation is unique for if there were two of like lowest degree, their difference would be of lower degree (pp. 15–16.)

(*b*) As any dyadic is homologous (commutative in multiplication, p. 14) with its powers and with I, the equation of lowest degree may be factored in the form:

$$\Lambda\,(\Phi) = (\Phi - aI)^p\,(\Phi - bI)^q\,(\Phi - cI)^r\;.\;.\;. = 0$$

identical with that obtained in factoring the ordinary polynomial

$$\begin{aligned}\Lambda\,(x) &= x^m + c_1\,x^{m-1} + \;.\;.\;.\; + c_{m-1}\,x + c_m \\ &= (x-a)^p\,(x-b)^q\,(x-c)^r\;.\;.\;. = 0.\end{aligned}$$

(*c*) If we set (p. 26)

$$\Phi - aI = \Psi,\; \Phi - bI = \Psi + (a-b)\,I,\; \Phi - cI = \Psi + (a-c)\;I,\;.\;.\;.$$

and if we divide (by the ordinary algorism of long division, which is applicable here) the expression

$$(\Phi - bI)^q\,(\Phi - cI)^r\;.\;.\;. = AI + B\Psi + \;.\;.\;.\; + H\Psi^{q+r+\cdots}$$

into I, we have the result

$$\frac{I}{A\,I + B\,\Psi + \ldots + H\,\Psi^{m-p}} = \frac{1}{A}I + B'\,\Psi + \ldots + G'\,\Psi^{p-1} + \frac{\Psi^p\,P\,(\Psi)}{A\,I + B\,\Psi + \ldots + H\,\Psi^{m-p}}$$

where P is a polynomial of degree $m - p - 1$. Next, let (p. 27)

Digitized by Google Original from HARVARD UNIVERSITY

$$I_a = (AI + B\Psi + \ldots + H\Psi^{m-p})\left(\frac{1}{A}I + B'\Psi + \ldots + G'\Psi^{p-1}\right)$$
$$= I - \Psi^p P(\Psi)$$

with similar expressions for I_b, I_c .... corresponding to each of the roots b, c, ... The dyadics I_a, I_b, ... are partial idemfactors, their squares are equal to themselves, they are independent, the product of two having different subscripts vanishes ($I_a I_b = 0$), and the sum of all is the idemfactor I.

(d) The dyadic Φ may be written as a sum of terms (p. 28)

$$\Phi = \Phi I = \Phi\ (I_a + I_b + \ldots)$$
$$= \Phi_a + \Phi_b + \Phi_c + \ldots$$

where the product of any two vanishes ($\Phi_a \Phi_b = 0$). The dyadics

$$Z_a = \Phi_a - aI_a\ , \ldots,$$

are nilpotent, i. e., $Z_a^p = 0$. The series of powers (p. 29)

$$Z_a,\ Z_a^2,\ \ldots,\ Z_a^{p-1},\ Z_a^p = 0$$

have increasing nullities, but the change of nullity between two succeeding powers never increases.

The reduction of Φ has thus been simplified to that of nilpotent dyadics Z. Beginning with Z_a^{p-1} we may work back through descending powers to Z_a and hence to Φ_a. We thus find the familiar result that, when expressed in matrical or quadrate form, Φ consists of a set of terms along the main diagonal, with at most some terms in the next parallel partial diagonal (called shearing terms, p. 31).

3. What additional information is obtainable if the dyadic is real? The steps in the proof may be traced one at a time.

(a') The equation of least degree must be real since it is unique—a complex equation is equivalent to two.

(b') The complex roots of $\Lambda(x) = 0$ occur in conjugate pairs of the same multiplicity. Hence if a and b are conjugate imaginaries, p and q are equal.

(c') If a and b are conjugate imaginaries, so are $\Phi - aI$ and $\Phi - bI$, and hence so must be I_a and I_b, for they are obtained by similar real operations applied to conjugate imaginaries.

Digitized by Google Original from HARVARD UNIVERSITY

(d') If a and b are conjugate, so are Φ_a and Φ_b, and Z_a and Z_b. If Z_a is reduced to a certain standard form, one form of the conjugate imaginary dyadic Z_b will be that in which each vector (antecedent or consequent) and each scalar in Z_a is replaced by its conjugate value. Hence the types of Z_a and Z_b or of Φ_a and Φ_b must be identical relative to the distribution of shearing terms.

The results thus obtained allow us to set up canonical forms for real dyadics which have imaginary latent roots. As the antecedents α, β, . . . of the dyads occur in conjugate imaginary pairs, the consequents which form the reciprocal set α', β', . . . (p. 8) also occur in conjugate imaginary pairs (since they are obtained by multiplication and division).

If there is a pair of simple roots, the corresponding terms in the reduced form of the dyadic are $a\ \alpha \mid \alpha' + b\ \beta \mid \beta'$ where

$$\alpha'\,\alpha = \beta'\,\beta = 1, \qquad \alpha'\,\beta = \beta'\,\alpha = 0,$$

owing to the relations between reciprocal sets. We may write

$$\begin{aligned} a &= a_1 + a_2\, i & b &= a_1 - a_2\, i \\ \alpha &= \alpha_1 + \alpha_2\, i & \beta &= \alpha_1 - \alpha_2\, i \\ \alpha' &= \alpha_1^0 - \alpha_2^0\, i & \beta' &= \alpha_1^0 + \alpha_2^0\, i \end{aligned}$$

with the reciprocal relations yielding

$$\begin{aligned} \alpha_1^0\,\alpha_1 + \alpha_2^0\,\alpha_2 &= 1 & \alpha_1^0\,\alpha_2 - \alpha_2^0\,\alpha_1 &= 0 \\ \alpha_1^0\,\alpha_1 - \alpha_2^0\,\alpha_2 &= 0 & \alpha_1^0\,\alpha_2 + \alpha_2^0\,\alpha_1 &= 0 \end{aligned}$$

when real and imaginary parts are separated. Hence

$$\alpha_1^0\,\alpha_2 = \alpha_2^0\,\alpha_1 = 0 \qquad \alpha_1^0\,\alpha_1 = \alpha_2^0\,\alpha_2 = \tfrac{1}{2}$$

If we set $\alpha_1' = 2\alpha_1^0$, $\alpha_2' = 2\alpha_2^0$, the sets α, β, . . . and α', β', . . . may be replaced by α_1, α_2, . . . and α_1', α_2', . . .

On multiplying, the terms $a\,\alpha \mid \alpha' + b\,\beta \mid \beta'$ give

$$\begin{matrix} a_1\alpha_1 \mid \alpha_1' + a_2\alpha_1 \mid \alpha_2' \\ a_2\alpha_2 \mid \alpha_1' + a_1\alpha_2 \mid \alpha_2' \end{matrix} \quad \text{or} \quad \begin{matrix} s\cos\theta\ \alpha_1 \mid \alpha_1' + s\sin\theta\ \alpha_1 \mid \alpha_2' \\ -\,s\sin\theta\ \alpha_2 \mid \alpha_1' + s\cos\theta\ \alpha_2 \mid \alpha_2' \end{matrix}$$

if $a = se^{\theta i}$. This is precisely of the Gibbs cyclotonic form, as might have been anticipated. The linear transformation or strain is a combination of stretching with elliptical rotation.[4]

[4] An elliptical rotation of angle q is a projection of an ordinary rotation of angle q. See Vector Analysis, p. 349.

Digitized by Google Original from HARVARD UNIVERSITY

The proof here given differs radically, however, from that given by Gibbs[5] for the simple three dimensional case; it applies, moreover, to any pair of conjugate latent roots, simple or not, when shearing terms are absent.

In case there is a double complex root with shearing, the terms in the reduced complex form of the dyadic are

$$a\alpha \mid \alpha' + a\gamma \mid \gamma' + \alpha \mid \gamma' + b\beta \mid \beta' + b\delta \mid \delta' + \beta \mid \delta'$$

Multiplication shows that the corresponding real form is, in matrical notation, as follows:

$s \cos\theta$	$s \sin\theta$	1	0
$-s \sin\theta$	$s \cos\theta$	0	1
0	0	$s \cos\theta$	$s \sin\theta$
0	0	$-s \sin\theta$	$s \cos\theta$

The extension to the case of multiple roots with various shearing terms is clear. In the matrix there are two-rowed determinants strung along the main diagonal, all alike; and parallel to the main diagonal there are strung along with any distribution (depending on the distribution of the original shearing terms) two-rowed determinants, all alike, and of the special form shown above; all other places are filled with zeros.

The transformation in the case of multiply complex roots with shearing might be called a cyclotonic shear. It consists of a stretch and of an elliptic rotation in a series of planes P_1, P_2, . . . , P_{k-1}, P_k, the angles of rotation and the factors of stretching being the same for all, combined with a shift of the points in P_{h+1} parallel to P_h for at least some values of h. The amount of the shift is typical of the shear. For instance, in the case of a triple complex root with double shearing the vector

$$\rho = x\alpha_1 + y\alpha_2 + z\gamma_1 + w\gamma_2 + u\epsilon_1 + v\epsilon_2$$

suffers, in addition to the stretch and elliptical rotation, the shift

$$+ z\alpha_1 + w\alpha_2 + u\gamma_1 + v\gamma_2.$$

[5] GIBBS-WILSON. Vector Analysis, p. 360.

Digitized by Google Original from HARVARD UNIVERSITY

MINERALOGY.—*Halloysite from Colorado.*[1] ESPER S. LARSEN, Geological Survey, and EDGAR T. WHERRY, National Museum.

In the upper workings of the fluorite mine at Wagon Wheel Gap, Colorado, two amorphous hydrous aluminium silicates have been recognized which agree more or less closely with halloysite as defined by Dana but differ from one another considerably in water content. One has essentially the composition of kaolinite, but is for the most part sensibly isotropic and has the index of refraction 1.557. It occurs in rather large amount as

TABLE 1

ANALYSES AND THEORETICAL COMPOSITION OF HALLOYSITE

	1	2	3	4
Al_2O_3	35.75	35.41	35.58	34.66
Fe_2O_3	tr.	tr.	tr.	......
CaO	0.80	0.73	0.77	......
MgO	tr.	tr.	tr.	......
K_2O	tr.	tr.	tr.	......
Na_2O	0.10	0.09	0.10	......
SiO_2	39.95	40.22	40.09	40.90
H_2O below 100°	8.55	8.66	10.73	12.22
H_2O 100°–400°	2.15	2.10		
H_2O above 400°	12.85	12.91	12.88	12.22
Total	100.15	100.12	100.15	100.00

1 and 2. Analyses of halloysite.
3. Average of 1 and 2.
4. Theoretical for $Al_2O_3 . 2SiO_2 . 2H_2O . 2Aq$.

TABLE 2

LOSS OF WATER BY HALLOYSITE[2]

TEMP. °C	PER CENT LOSS	TOTAL
20	Started	
30	6.40	8.60
40	0.90	
50	0.75	
60	0.50	
100	0.05	
110	0.00	
150	0.10	2.10
200	0.40	
300	0.60	
400	1.00	
Ign.	12.90	12.90

the matrix in which the mineral creedite is imbedded and has been called "isotropic kaolinite."[3] The other contains more

[1] Published with the permission of the Director of the U. S. Geological Survey and of the Secretary of the Smithsonian Institution.

[2] LOWENSTEIN (Zeit. Anorg. Chem., 63: 88–101. 1909), found that halloysite from Laurium, Greece, lost 21.4 per cent H_2O at 110°–130° or over 97 per cent H_2SO_4, and 6.2 per cent above 130°, but most halloysites cited by Dana behave like the one here described.

[3] LARSEN, ESPER S., and WELLS, ROGER C. *Some minerals from the fluorite-barite vein near Wagon Wheel Gap, Colordo.* Proc. Nat. Acad. Sci., 2: 360. 1916.

Digitized by Google Original from HARVARD UNIVERSITY

water, and is less abundant, forming a matrix for nodules of gearksutite. It is white and opaline to dull in appearance, and has a hardness of about 2. Under the microscope it is isotropic and has a variable index of refraction, averaging about 1.470 ± 0.010 when first examined, but increasing to 1.542 after standing for six months in a loosely stoppered bottle in a warm room.[4]

Analysis (by E. T. W.) yielded the results shown in Table 1.

TABLE 3

CHANGE IN OPTICAL PROPERTIES OF HALLOYSITE WITH LOSS OF WATER

HISTORY OF MINERAL	TOTAL H_2O. (APPROX.)	OPTICAL CHARACTER	n.
	per cent		
As first examined, two months after collecting	25	Isotropic	1.470±0.010
After standing six months in a loosely stoppered bottle	20	Isotropic	1.542±0.005
Heated for four hours to 65°C. This has the composition and index of the "isotropic kaolinite," which is evidently only a halloysite low in H_2O	15	Isotropic	1.555±0.003
Ignited powder, after standing one month	0	Partly isotropic but partly birefracting due to strain; clouded	1.541±0.003
Powder ignited, quickly cooled, and immersed in index medium (organic liquid of known n)	0	In large part isotropic but some fragments have birefringence of 0.01, with large axial angle	1.535±0.005

[4] Two halloysites represented by analyses A and B of U. S. Geol. Survey Bull. 591: 341, were examined microscopically for comparison. That represented by analysis A, from Horse Cove, Hart County, Kentucky, is pale pinkish in color and opaline in appearance. Much of it is weakly birefracting and large areas extinguish much as a unit but with a wavy effect, probably due to strain. The index of refraction is about 1.549 ± 0.003. The halloysite represented by analysis B, from Edwards County, Texas, is chalky in appearance, largely isotropic, and has an index of refraction of 1.556 ± 0.003, but contains admixed a considerable amount of birefracting kaolinite. However, to what extent their indexes have changed since analysis is unknown.

Digitized by Google Original from HARVARD UNIVERSITY

The water determinations (Table 2) were made by heating coarse powder in a covered platinum dish. The powder not used was kept for three months in a small vial in a balance case in which the air was dried with sulfuric acid, and was then found to have lost spontaneously 5 per cent of water. Obviously, the water in halloysite is in part only mechanically held. This part is given off very readily, and the resulting partially dehydrated material has a composition near that of kaolinite. The formula should therefore probably be written $Al_2O_3.2SiO_2.2H_2O.Aq$.

The effects of the loss of water on the optical properties are shown in Table 3.

The close approach of this and many other analyses of halloysite to the composition $Al_2O_3.2SiO_2.2H_2O.Aq$, combined with the results of optical examination given above, indicates that the material called halloysite is the amorphous mineral corresponding to crystalline kaolinite, holding through capillarity or adsorption more or less excess water.

ORNITHOLOGY.—*Diagnosis of a new laniine family of Passeriformes.* HARRY C. OBERHOLSER, Bureau of Biological Survey.

The peculiar shrike-like Madagascar genus *Tylas* has commonly been considered a member of the family Pycnonotidae. This disposition has probably been due to its nuchal hairs, and to the character of its external nares, which in general resemble those of the genus *Otocompsa.*

As Mr. W. P. Pycraft has recently shown,[1] this genus is really not closely allied to the Pycnonotidae. Neither is it a member of the Prionopidae, to which family Mr. Pycraft has proposed to refer it, apparently for want of a more satisfactory place. While in some osteological respects it resembles the Prionopidae, it has also resemblances to the Muscicapidae, and, on the whole, presents a very curious combination of characters, a condition reflected in the difficulty authors have had in referring it to the proper family.

That it does not belong in the Prionopidae is at once evident

[1] Proc. Zool. Soc. Lond., 1907, p. 376.

Digitized by Google Original from HARVARD UNIVERSITY

from the structure of the narial capsule alone, which in the latter group is fully ossified as in the Laniidae, leaving no external nasal fossa. Since there is no other family to which the genus *Tylas* is properly referable, it becomes necessary to provide one for its accommodation, as follows:

Tylidae, fam. nov.

Family characters.—Bill relatively slender and thrush-like, the culmen rather sharply ridged, the gonys rounded and but slightly and gradually ascending, the culmen straight for its basal half, gently decurved terminally; mental apex opposite anterior end of nostril; maxilla conspicuously hooked at tip, the commissural edge notched subterminally; nostril rather small, oval, non-operculate, exposed, and situated in the anterior end of nasal fossa; nasal capsule not ossified; feathering of forehead covering only basal portion of nasal fossae; narial bristles rather weak, but reaching to middle of bill; rictal bristles well developed; head entirely feathered; nuchal hairs present but short; tail moderately long, making up somewhat less than half the total length of the bird, square or slightly emarginate, and composed of moderately broad, stiffish feathers; wings much longer than tail but much rounded, the first (outermost) primary spurius, but more than half as long as the next, and neither secondaries nor tertials lengthened; feet and legs of moderate size and length; tarsi scutellate; femur pneumatic; ectepicondylar process of humerus much reduced.

The genus *Tylas* Hartlaub, comprising the following five species, constitutes this monotypic family: *Tylas eduardi* Hartlaub; *Tylas alfredi* Sharpe; *Tylas albigularis* Hartlaub; *Tylas fulviventris* Sharpe; *Tylas strophiatus* Stejneger.

ANTHROPOLOGY.—*Remarks on terms of relationship.*[1] TRUMAN MICHELSON, Bureau of American Ethnology.

Some years ago Kroeber[2] undertook to show that terms of relationship are linguistic and psychological phenomena. Re-

[1] Published with the permission of the Secretary of the Smithsonian Institution.

[2] Journ. Roy. Anthrop. Inst. Gr. Brit. and Irel., **39**: 77–84. 1909.

Digitized by Google

Original from
HARVARD UNIVERSITY

cently Rivers[3] has attempted to overthrow this view, holding that they are sociological phenomena, and consequently that it is entirely possible to infer marriage customs and social organization from these terms. Lowie[4] to a certain extent followed Rivers but has not followed the latter's survival-theories, nor is it likely that many American ethnologists will do so.[5] The present writer[6] developed Kroeber's linguistic thesis from a different angle, and also made a new point, namely, that terms of relationship are likewise disseminative phenomena. Specific data from Algonquian tribes were given to establish these facts. Lowie,[7] some months later, but quite independently, arrived also at this second theoretic position but extended the principle more broadly than the present writer had done. It is not without interest to note that we both assume that Iroquoian and Siouan influence has played a part in Algonquian terms of relationship. Sapir[8] briefly touches upon the methodological considerations and concludes that thoroughly satisfactory results can not be secured without linguistic analysis of kinship terms; that existing nomenclature may be retained in the face of sociological developments requiring its modification; that the factors governing kinship nomenclature are very complicated. Goldenweiser,[9] in his review of Rivers' *History of Melanesian Society*, says, "A set of terms must always remain a feature of language and as such it is subject to those influences which control linguistic changes as well as to the peculiar spirit of a particular language or linguistic stock." The present writer[10] has shown what extraordinary types of marriage we should have to assume existed formerly among the Piegans, were we to believe that marriage customs

[3] Kinship and Social Organization, 1914. The History of Melanesian Society, 1914.

[4] Proc. Nat. Acad. Sci., **1**: 346–349. 1915. Amer. Anthrop. n. ser., **17**: 223–239, 329–340, 588–591. 1915.

[5] Webster (Amer. Anthrop., n. ser., **17**: 175–177. 1915) is an isolated exception.

[6] Proc. Nat. Acad. Sci., **2**: 297. May, 1916.

[7] Holmes Anniversary Volume, 293. December, 1916.

[8] Amer. Anthrop., n. ser., **18**: 327, footnote 1. 1916.

[9] Science, n. ser., **44**: 826. 1916.

[10] Holmes Anniversary Volume, 333. 1916.

Digitized by Google
Original from HARVARD UNIVERSITY

might safely be inferred from terms of relationship; whereas such marriages are fundamentally repugnant to the Piegans, and their terms of relationship are new, not old. This is, of course, a concrete example of one of Sapir's points. Recently Swanton[11] quite similarly brings forward data from Creek and Chickasaw which prove the unsoundness of such inferences.

The above has been cited to show that American ethnologists generally have taken a united stand against Rivers' one-sided attitude. I reopen the case because none of us has given absolute proof that kinship terms are borrowed. In another place[12] I have tried to prove that Cree has borrowed certain terms from Ojibwa; and somewhat similarly that Peoria has been influenced by Sauk, etc. I think the reasoning given there is sound, and as near absolute proof as we can expect to have in the case of prehistoric linguistic borrowing; yet it is not absolute in so far as we have no Cree nor Ojibwa records transmitted to us historically, extending over several centuries, showing absolutely that such borrowing took place. The same is true regarding Peoria. English is a good language to draw on for illustrative material to prove such a point, for it has been transmitted historically for several centuries. Every Indo-European philologist knows that *sister* is Scandinavian in origin, and that *cousin, niece, nephew, aunt,* and *uncle* are Romance. Furthermore all our terms of *-in-law* are directly or indirectly due to the latter's influence; *grand-father* and *grand-mother* are Romance in the first member of their compounds. Similarly Albanian *frat* "brother" is Romance in origin and is not a native word, as is shown by the phonetics. In the same way Hungarian *barát* "brother" is borrowed from Slavic, a case of borrowing across linguistic stocks. [Ojibwa *nimpāpa, nimāmā* (Fort William) are other illustrations of kinship terms borrowed across linguistic stocks.] These facts, long known, are brought forward simply because they seem to have escaped the attention of ethnologists. Delbrück[13] was well aware of the fact that Indo-European terms of relationship

[11] Amer. Anthrop. n. ser., **18**: 463. 1916 [1917].

[12] Proc. Nat. Acad. Sci., **2**: 297. 1916.

[13] Die Verwandtschaftsnamen. Leipzig. 1889. Also in Abh. phil.-hist. Klasse sächs. Ges. Wiss., **11**: 379. 1889.

Digitized by Google Original from HARVARD UNIVERSITY

are linguistic phenomena. Several terms that correspond phonetically occur in so many Indo-European languages that it is evident they belonged to the Indo-European parent language. The social organization of the peoples speaking the historical languages had nothing to do with it, as is shown by their diverse social organization. Nor can it be said that such German compounds as *Schwieger-mutter*, *Schwieger-vater*, *Schwieger-tochter* have replaced the Old High German words by reason of a change in social organization. Similarly, the fact that the Slavic word for "father" (Old Bulgarian *otĭcĭ*) has a different termination than Greek *ἄττα*, Gothic *atta*, is of linguistic significance, not sociological. These data support my contenion referred to previously.[4]

Let us return once more to Rivers' position. On looking over the tables given at the end of volume 1 of Rivers' *History of Melanesian Society*, I am convinced that after all, he may have just as much a linguistic and disseminative problem as a sociological one. For example, the social organization of Mota, Banks Islands, and Eddystone, Solomon Islands, is entirely different; nevertheless the terms for *father*, *elder brother*, and *younger brother* are evidently the same. Furthermore, the distribution of slightly varying forms of the words *tama*, *tina* (*father* and *mother* respectively) even across linguistic stocks, points in the same direction. As I am not a specialist in Melanesian and Polynesian linguistics, I regret that I can not thresh this out to the end, and can only indicate a problem for others to solve.

Digitized by Google Original from HARVARD UNIVERSITY

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

GEOLOGY.—*Contributions to the geology and paleontology of San Juan County, New Mexico. 2. Vertebrate faunas of the Ojo Alamo, Kirtland, and Fruitland formations.* CHARLES W. GILMORE. U. S. Geological Survey Professional Paper 98–Q. Pp. 279–308, with 8 plates and 13 figures. 1916.

The known vertebrate fauna of the dinosaur-bearing beds in the San Juan basin in northern New Mexico consists of a considerable number of genera and species. The dinosaur-bearing deposits are subdivided into three formations—the uppermost, or Ojo Alamo, the Kirtland, and the Fruitland. No mammal, bird, or amphibian remains have yet been recorded from these formations. The dinosaurs were apparently the predominating vertebrates of these times, and they afford the best basis for a comparison with forms found elsewhere. The vertebrate remains from the Ojo Alamo, Kirtland, and Fruitland formations show beyond all question that they pertain to a fauna or faunas distinctly older than that of the Lance, and such evidence as there is contributes to the support of the contention that the Ojo Alamo sandstone is synchronous with the Judith River and Belly River formations as found in areas to the north. R. W. S.

GEOLOGY.—*Contributions to the geology and paleontology of San Juan County, New Mexico. 3. Nonmarine cretaceous invertebrates of the San Juan basin.* T. W. STANTON. U. S. Geological Survey Professional Paper 98–R. Pp. 309–326, with 5 plates and figures. 1916.

Overlying the Pictured Cliffs sandstone with apparent conformity in the San Juan basin and underlying the Puerco formation is a group of nonmarine sediments, coal bearing in the lower part, which in many previous reports have been referred more or less doubtfully to the Laramie formation. The rocks occupying this interval are fully described

Digitized by Google

Original from HARVARD UNIVERSITY

and a considerable area of them is mapped in a stratigraphic paper by C. M. Bauer, who recognizes in them three formations, the Fruitland formation containing all the coal beds at the base, the Kirtland shale in the middle, and the Ojo Alamo sandstone at the top. The invertebrates, which form the subject of the present paper, nearly all come from the Fruitland formation.

The list of species shows that the nonmarine invertebrates of the Fruitland formation include both a fresh-water fauna and a brackish-water fauna. The fresh-water fauna is especially notable for the greatly varied development of the genus Unio and for the abundance and considerable variety of the gastropods. The invertebrate evidence as a whole favors the assignment of the Fruitland formation to an epoch considerably later than Mesaverde and Judith River, and possibly somewhat earlier than Lance. The Fruitland can hardly be older than Fox Hills, and the sequence from the base of the Fruitland up to the top of the Ojo Alamo, which is conformable, may include the equivalents of everything from the Fox Hills to the Lance inclusive.

R. W. S.

GEOLOGY.—*Contributions to the geology and paleontology of San Juan County, New Mexico. 4. Flora of the Fruitland and Kirtland formations.* F. H. Knowlton. U. S. Geological Survey Professional Paper 98–S. Pp. 327–353, with 8 plates and figures. 1916.

The object of the present study is to ascertain the bearing of the fossil plants on the age of the series of coal-bearing and related rocks in San Juan basin, New Mexico. A brief historical setting for the geologic facts is given. The material on which the present report is based comprises 20 collections, of which 15 are from the Fruitland formation, 3 from the Kirtland shale, and only 1 from the Ojo Alamo sandstone. The bulk of the material comes from the lower or coal-bearing portion of the section, and much of this is preserved on a red baked shale, indicating proximity to coal. Of the 40 forms making up the known flora of the Fruitland and Kirtland formations, 16 have been found in other areas, and the list of these forms brings out the fact that no less than 15 are known to occur in the Montana. A further analysis of the list shows that 12 of the 15 forms occur in the Vermejo formation of Colorado and New Mexico, 10 occur in the Mesaverde, or rocks of about this age, in Wyoming and elsewhere, and 6 species are common to both these areas. On the basis of this showing the conclusion that the Fruitland and Kirtland formations are of Montana age, seems justified. R. W. S.

Digitized by Google Original from HARVARD UNIVERSITY

PHYTOPATHOLOGY.—*Mechanism of tumor growth in crown gall.* ERWIN F. SMITH. Journ. Agr. Research, **8**: 165–186, plates 4–65. 1917.

This paper, with its wealth of illustrations, records the results of a series of experiments testing the effects of various fluids and vapors on plants, undertaken for the purpose of shedding light on the mechanism of tumor growth in crown gall. As a result of these studies the author has come to look upon excessive cell proliferation as it occurs in plant neoplasms as due, not to the *direct* application of stimuli such as endotoxins and other by-products of the growth of the parasite within the host cells, but to their *indirect* action as the removers of inhibitions. Growth is the normal function of cells but under normal conditions is always inhibited beyond a certain point. *In the case of neoplasms we have an "inhibition remover that acts locally, disturbing tissue equilibriums within limited areas."* The author believes, furthermore, that this removal of growth inhibitions is not (or not wholly) due to a chemical action but partly at least to a physical one—viz., a locally increased osmotic pressure produced by the diffusion from the cells of various substances produced within them by the parasite as a result of its metabolism, together with the resultant counter movements of water and food supply, basing this belief upon the researches of Jacques Loeb in artificial parthenogenesis and fertilization, and on the results of his own experiments.

The substances produced by *Bacterium tumefaciens* in culture media containing dextrose, Witte's peptone, calcium carbonate, and water are ammonia, alcohol, acetic acid, formic acid, amines, aldehyde, and acetone. With several of these compounds, the author produced intumescences (both hypertrophic and hyperplasial) without the intervention of the organism itself. In addition to obtaining small tumors with crown-gall products (ammonia, dimenthylamine, and acetic acid) the author obtained overgrowths with a great variety of other substances; hence his conclusion that the response must be physical rather than chemical, i.e., due to removal of water from cells, which then divide.

The plants used were the castor-oil plant (*Ricinus communis*), tomato fruits, and cauliflower. The substances tested were injected hypodermically (Ricinus and tomato), placed in tiny open tubes inserted in the pith cavity (Ricinus, the wound being sealed with collodion or adhesive tape), or vaporized in a tight box containing 10.5 cubic feet air space in which the plants (cauliflower) were placed for a

Digitized by Google Original from HARVARD UNIVERSITY

few minutes. The substances tested were ammonia water, the various salts of ammonia, distilled water solutions of the acid component of these salts, distilled water, 10 per cent tannic acid, 10 per cent ethyl alcohol, 2 per cent sodium chlorid, 2 per cent sodium carbonate, 5 per cent sodium bicarbonate, 1/20 normal sodium hydroxid, 5 per cent ammonium bicarbonate, clear lime water, milk of lime (caustic), 1 to 10,000 mercuric chloride, 0.5 per cent carbolic acid, chloroform water, 1 to 1,000,000 copper sulphate water, 5 per cent grape sugar, 5 per cent cane sugar, and feeble alkaline vapors arising from dilute solutions of urea, ammonium carbonate, and the two ammonium phosphates, the mixed vapors of ethyl alcohol and acetic acid, and the vapor of secondary methylamine.

With all these substances, even distilled water, proliferations were obtained, but no killing of cells resulted except in the case of those coming into direct contact with too strong a solution. In Ricinus when ammonia was applied, the outgrowths were from the inner surface of the pith cavity, and occurred not only in the internode containing the chemical but in several to many others above and below.

Exclusive of the hyperplasia which appeared when vapor of acetic alcohol was used, one of the most striking effects obtained was the production of a stele within a stele in the pith of Ricinus by the injection of monobasic ammonium phosphate, and evidences of similar tendencies when ammonia was used. These facts together with the author's very successful production of teratoid tumors with *Bacterium tumefaciens* lead him to believe that fasciations and many similar phenomena are due to feeble infections by micro-organisms.

From these experiments the author concludes "that any soluble substance whatsoever, except a killing, a plasmolyzing, or an oxygen-absorbing substance, if continually liberated in excess locally in tissues not adapted to them would be able to induce tumor formation, and is convinced that had it been possible to apply these stimuli repeatedly, or better still, slowly and continually from within the cell—as does the parasite in crown gall—these striking proliferations would have developed into large irregular tumors, rupturing to the surface, i.e., into typical crowngalls. It is believed that this is the first time that galls have been produced with the chemical products of a gall-forming organism. The nature of the crown-gall products were determined for Doctor Smith by the Bureau of Chemistry of the United States Department of Agriculture from flask cultures set and controlled by him. F. H.

Digitized by Google
Original from
HARVARD UNIVERSITY

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 784th meeting was held at the Cosmos Club, February 17, 1917, President BUCKINGHAM in the chair; 69 persons present. The minutes of the 783rd meeting were read in abstract and approved.

By invitation, Mr. H. BATEMAN presented an illustrated paper on *The nature of chemical forces.* Sir Joseph J. Thomson's idea[1] of regarding chemical bonds as symbols for Faraday tubes may be developed successfully by considering solutions of Maxwell's electromagnetic equations in which the electric and magnetic forces become infinite on moving singular curves.

We must first of all try to understand the nature of potential energy and so we shall commence by studying the properties of a type of radiant field with singular lines starting from the origin and running in both directions along the axis of z. The electric force E and the magnetic force H being specified by expressions of type

$$\begin{aligned} H_x + i\,E_x &= f(\alpha, \beta)\frac{\partial(\alpha, \beta)}{\partial(y, z)} \\ H_y + i\,E_y &= f(\alpha, \beta)\frac{\partial(\alpha, \beta)}{\partial(z, x)} \\ H_z + i\,E_z &= f(\alpha, \beta)\frac{\partial(\alpha, \beta)}{\partial(x, y)} \end{aligned} \qquad (1)$$

where $\alpha = t - \frac{r}{c}, \qquad \beta = \log\frac{x + i\,y}{r - z}, \qquad r^2 = x^2 + y^2 + z^2$

it is easy to see that there is a radial flow of energy outward from the origin. The origin O may be regarded as a source or singular point at which neutral particles are continually breaking up into oppositely charged fragments which travel along the axis of z in opposite directions with the velocity of light.

Two neighboring sources O and O' whose singular lines overlap can produce radiant fields which interfere with one another in such a way that in the total field the only singularities lie in the interval OO'. This can be seen very readily by differentiating the expressions (1)

[1] The corpuscular theory of matter. Constable, London (1907). Phil. Mag., May. 1914.

Digitized by Google
Original from HARVARD UNIVERSITY

with respect to z after putting $f(\alpha\beta) = 1$ and writing down the values of the Jacobians. In particular, if the strengths $f(\alpha\beta)$ of the two sources are constants which are equal in magnitude but different in sign, then as O and O' approach one another the total electromagnetic field is in the limit equivalent to the electrostatic field of a point charge, the magnitude of the charge being the limit of the product OO' and the strength of one of the sources. The potential energy of an electrostatic field can thus be supposed to arise from the individual and mutual energies of two interfering radiant fields whose singular lines overlap.

When the strengths of the two consecutive sources OO' are not constant and not equal in magnitude, we obtain a type of electric point charge with two singular lines attached to it, the charges on the two lines being generally variable and together equal and opposite to the variable charge associated with the singular point. The case in which the charge on each singular line is the same is of chief interest.

Interference, or a cancelling out of singularities, can also be obtained with two point charges of this general type even when they are at a finite distance apart, provided their singular lines overlap. There must also be a simple relation between the magnitudes of the two charges at associated times; this indicates that it may be possible to give a mathematical proof that the mean value of the electronic charge is the same for all electrons. It is thought that this phenomenon may have some relation to chemical saturation. The present theory may be extended to the case in which the sources or point charges are moving and the singular curves are not straight lines pointing in opposite directions but are moving and changing in shape. The appropriate solution of Maxwell's equations is again of the type (1) but α and β are now defined by the equations.

$$[x-\xi(\alpha)]^2+[y-\eta(\alpha)]^2+[z-\zeta(\alpha)]^2=c^2[t-\alpha]^2,\ \alpha<t,$$

$$\beta=\log\frac{l_1(\alpha)[x-\xi(\alpha)]+m_1(\alpha)[y-\eta(\alpha)]+n_1(\alpha)[z-\zeta(\alpha)]-cp_1(\alpha)(t-\alpha)}{l_0(\alpha)[x-\xi(\alpha)]+m_0(\alpha)[y-\eta(\alpha)]+n_0(\alpha)[z-\zeta(\alpha)]-c(t-\alpha)}$$

where $\xi(\tau)$, $\eta(\tau)$, $\zeta(\tau)$ are the coordinates of the source at time τ and $l_0(\alpha)$, $l_1(\alpha)$, $m_0(\alpha)$, $m_1(\alpha)$, $n_0(\alpha)$, $n_1(\alpha)$, $p_1(\alpha)$, are functions of α connected by the equations

$$l_1^2+m_1^2+n_1^2=p_1^2 \qquad l_1(\alpha)\,\xi(\alpha)+m_1(\alpha)\,\eta(\alpha)+n_1(\alpha)\,\zeta(\alpha)-cp_1(\alpha)=0$$

$$l_0^2+m_0^2+n_0^2=1 \qquad l_0 l_1+m_0 m_1+n_0 n_1=1$$

This theory may be developed and applied to problems of atomic and molecular structure. Thomson's Faraday tubes are regarded as singular curves of generalized point charges and an arrow may be used to signify the direction of the flow of energy along a Faraday tube. The result of chief importance is that an *even* number of singular curves should be supposed to start from each point charge, the number being proportional to the mean value of the charge. It is suggested that the valency electrons in an atom are each doubly con-

Digitized by Google Original from HARVARD UNIVERSITY

nected by singular curves with the same element of the positive nucleus, while the other electrons in the atom have their singular curves connected with *different* elements of the positive nucleus and, like the electrons in the nucleus, help to keep the elements of the nucleus together. A change in valency may be associated with a change in the distribution of the singular curves or Faraday tubes. Thus, if the carbon atom contains six outer electrons two of which generally serve to bind together two nuclear elements each carrying three positive charges, it would be possible for the valency of carbon to change from four to two but not to any other value. Similarly, if the nucleus of the oxygen atom contains four α-particles and there are eight external electrons, the only possible valencies for oxygen will be four and two. On the other hand, if the nucleus of nitrogen is built up from two α-particles and an element carrying a triple charge and there are seven external electrons, then it is possible for such an atom of nitrogen to exhibit valencies of one, three, four, or even five. Diagrams were shown illustrating these changes and suggesting a way in which energy may be locked up in an atom, and, as energy is generally radiated when a singular curve changes its shape and direction, it is easy to imagine how some of this energy is radiated away during a rearrangement of the singular curves. It should be noticed that when the variation in shape of a singular curve is caused by an oscillation of an electric charge at one end the width of the waves which travel along the curve increases at a rate which is roughly equal to the maximum velocity of the source. Now if the motion of the source is of type $x = a \sin \omega t$, the maximum velocity is $a\omega$ while the maximum acceleration is $a\omega^2$, consequently, if ω is very large, i.e., if the waves are of high frequency, the velocity $a\omega$ may be negligibly small while the acceleration $a\omega^2$ is appreciable. Thus the intense radiation which travels along the singular curve may be concentrated and act like a quantum of energy.

The analogy with Thomson's model of the benzene ring also suggests that arrangements of electrons and positive nuclei in which energy flows in a cycle along the Faraday tubes are generally very stable. The suggested theories of gravitation and atomic structure are reserved for later publication.

The chair expressed to Mr. Bateman the thanks of the society for the interesting paper.

Mr. L. B. Loeb then gave a paper on *The electron theory of valence.* The fact that the 87 elements now known can combine to form only a limited number of the nearly infinite combinations mathematically possible, is explained through the fact that certain very definite laws of combination seem to exist. The manifestations of certain regularities shown in these laws give rise to a property that is defined as valency, a property which seems to show a periodic variation with the atomic weight of the element. The forces causing these combinations are generally accepted as being electrical in nature. The history of this electrical concept of valency was briefly discussed, giving the contributions of the various discoverers up to 1906. Since 1910 marked

Digitized by Google Original from HARVARD UNIVERSITY

contributions have been made to the knowledge of the nature of the atom. The discussion of the bearing of these contributions (i.e., the existence of the positive nucleus in the atom as indicated by scattering and deflections of alpha particles by atoms, and the atomic number with its significant bearing on the nuclear charge, as shown by the experiments on the X-ray spectra of the elements and the chemistry of the radio-elements) on the nature of the forces acting between atoms, furnished the main body of the paper. The experimental results indicate that the atom is entirely electrical in nature with a highly concentrated electrically positive nucleus surrounded by neutralising negative electrons. Of these electrons those in the outer layer are active in chemical unions. The possibility that the chemical forces are due to the magnetic fields of electrons revolving in the atoms was shown for several different reasons to be highly improbable. The mode of action of the electrons in binding the atoms was discussed. The electrons were shown to be capable of binding atoms in two ways in the two great classes of chemical compounds, i.e., the compounds showing strong electrolytic dissociation, such as NaCl, and the compounds showing no dissociation, such as the organic compounds and molecules like O_2 and N_2. In the former class there seems to be a complete transfer of the electron from one atom to the other, the atoms being held together by the opposite charges on them due to the transfer. In the latter class the electrons probably lie midway between the two atoms, acting then as actual binding links between them. The two classes of binding merge into one another in compounds of intermediate type. The type of binding taking place between two atoms is governed entirely by the nature of the atoms as given by the periodic system. The bearing of the atomic number and of the periodic system on valency were then discussed. It was shown that according to an idea of J. J. Thomson, which has recently been elaborated by Kosseo, the valency activities of the elements may be explained by the assumption that the atomic number represents the nuclear charge, and that every atom, even at the expense of losing or gaining outer electrons and thus becoming electrically charged, attempts to achieve the outer electronic configuration of the inert gas which *immediately precedes* or follows it. Since the inert gases are assumed to have eight electrons in their outer stable layer, one can explain many regularities found in the periodic table, e.g. why it is that the sum of the negative and positive valencies are equal to eight. To make the facts presented more concrete, the speaker, after having pointed out its weaknesses, adopted the Rutherford saturnian atom with revolving electrons as the most satisfactory model. With this model it was shown by diagrams how, on a theory recently suggested by Kossel, various kinds of molecules might be built up from such an atom.

Mr. F. R. Bichowsky then spoke on *Valence and color*. He pointed out that the characteristic feature of chemical union is that the valence electrons are held in equilibrium by forces of attraction and repulsion, both of which are presumably electrical and both of which are due

Digitized by Google Original from HARVARD UNIVERSITY

solely to the atom nucleus. This means that to explain chemical union one must assume either that Coulomb's law does not hold for the total (resultant) electrical force acting on an electron in a molecule, or else that the electron is such that other than purely electrostatic forces can act on it. At the point of equilibrium there is acting on a valence electron a restoring force which measures the stability of the electron arrangement, i.e., the "reactivity" of the compound. The magnitude of this restoring force, as determined by valence considerations and as checked by information furnished by the visible and ultra-violet absorption spectra, shows that an arrangement of eight and not six forms the most stable grouping of electrons around the positive nucleus. This can not be explained on any plane model of the atom, as this grouping requires lack of radial symmetry in the electron or nucleus. Saturnian atom models are inadmissible. Either they will radiate energy at the absolute zero (contradicting thermodynamics) or else they can not radiate at all. New physical assumptions are needed to construct a successful atom model, as one can not be deduced from the ordinary solutions of Maxwell's equations, these solutions being incompatible with the properties of the positive nucleus as well as with its very existence. The static model of the atom is preferable as, although it requires new and startling assumptions about the nature of the electron and the positive nucleus, these assumptions need not contradict the classical theories of physics.

Informal communications. Messrs. W. W. Coblentz and W. B. Emerson presented to the Society a *Preliminary note on the selective reflection of tungsten.* The spectral radiation curves of incandescent tungsten filaments show peculiarities indicating the possibility of selective emission due to minima of reflection. The reflectivity curves of various metals, e.g. gold and copper, have in the visible spectrum indentations which give rise to strong selective emission in the incandescent metal. An examination of the spectral reflecting power curve of tungsten (in the form of plane highly polished mirrors) shows a small indentation at about 0.85 μ, which is greater than can be accounted for at present as being due to experimental errors. This depression in the reflectivity seems to be a property of the pure metal.

On account of the lateness of the hour, formal discussion was omitted.

Donald H. Sweet, *Secretary.*

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 313th meeting was held at the Cosmos Club, January 10, 1917.

INFORMAL COMMUNICATIONS

J. S. Diller: *More evidence as to the high temperature of the late eruption of Lassen Peak.*

REGULAR PROGRAM

George Otis Smith: *Geology and public service.* (Published in The Scientific Monthly, February, 1917.)

Digitized by Google

Original from
HARVARD UNIVERSITY

J. Wayland Vaughan: *Significance of reef coral fauna at Carrizo Creek, Imperial County, California.* The paper gave a brief presentation of the zoogeographic relations of the fossil coral fauna of Carrizo Creek, showing the fauna to be related to the faunas of Pliocene and post-Pliocene age in Florida and the West Indies and on the eastern coast of Central America. The geologic history of the Tertiary coral faunas of the southeastern United States, the West Indies, and Central America was summarized. The conclusion was announced that subsequent to the uplift which separated the Atlantic and Pacific oceans at the close of Apalachicolan (upper Oligocene) time, there was during late Miocene or Pliocene time connection between the Atlantic and Pacific oceans, perhaps in the vicinity of the Isthmus of Tehuantepec, and that the Atlantic coral fauna extended up to the head of the Gulf of California. Factors not clearly understood excluded the Pacific fauna from this area.

Discussed by Mendenhall, Bartsch, and Macdonald.

The 314th meeting was held at the Cosmos Club, January 24, 1917.

INFORMAL COMMUNICATIONS

A. L. Day: *Cooling of a lava surface.* On the basis of computations by C. E. Van Orstrand the bottoms of cracks 3 to 5 feet deep in the surface of an extruded lava should be glowing hot several days after the extrusion. Observers at Lassen Peak a few days after the recent eruption did not report any glow in the cracks.

Discussion: Sidney Paige described and submitted a large specimen as evidence of plasticity of the recent lava at Lassen Peak.

REGULAR PROGRAM

Arthur J. Collier: *Age of the high gravels of the Northern Great Plains.* The area discussed extends along the south side of the international boundary, from Redstone, 30 miles west of the North Dakota line, to Boundary Plateau, a distance of 175 miles. From Boundary Plateau it extends northwest to include the Cypress Hills, where the Canadian Geological Survey, in the years 1883, 1884, and 1904, collected fossils from Bone Coulee, which are Oligocene and equivalent to the White River in age. The formation is composed of more or less cemented gravel, sand, clay, and marl characterized by water-worn quartzite pebbles from the Rocky Mountains. It rests on a plateau whose elevation above tide is 4800 feet at its west end and 3700 feet at its east end, near Bone Coulee.

During the past two field seasons the United States Geological Survey has made an investigation of the lignite resources of the region, in the course of which fragments of vertebrate remains were collected from 27 localities. These fragments, which came from wells, railroad cuts, badger holes, and natural exposures, have been submitted to Dr. J. W. Gidley, who reports that they can not be older than Miocene nor younger than Lower Pliocene. The formation called the Flaxville,

Digitized by Google Original from HARVARD UNIVERSITY

from which this material was collected, is composed of brownish to ash-gray silt, sand and gravel, and white marl from a few feet to 100 feet thick. It is generally noncoherent but locally cemented with calcite and forms prominent outcrops, often marked by cross-bedding. The gravel is characterized, like that of the Cypress Hills, by material from the Rocky Mountains. It is found on four extensive plateaus ranging in elevation from 2700 feet, south of Redstone, to 3200 feet in the west side of Boundary Plateau.

Below the Flaxville level there are extensive areas, varying in elevation from 2500 to 2700 feet, in which the bedrock is generally near the surface. Several exposures of quartzite gravel interstratified with yellowish silt lie at an elevation of 2500 feet a few miles north of Milk River. A single fossil tooth collected from the gravel was submitted to Dr. Gidley, who pronounces it either a recent or Pleistocene horse. The erosion of these large areas is thought to have been accomplished in early Pleistocene time. Since early Pleistocene the streams have eroded their valleys, but this erosion was clearly before the last great glacial advance, and the valley floors are therefore regarded as having been formed during late Pleistocene and Recent times.

Discussion: W. C. ALDEN said the gravels are well rounded, and that erosion to a depth of at last 1000 feet occurred between the time of an older glaciation and the Wisconsin. J. W. GIDLEY suggested that the fossils in the gravels were derived from older formations.

J. C. HOSTETTER: *The linear force of growing crystals.* The literature on this subject shows that a loaded crystal will grow against a load and lift it. This was first demonstrated by Becker and Day in 1905 and, although their conclusions were attacked by Bruhns and Mecklenburg in 1913, the recent papers of Taber and of Becker and Day show definitely that the linear force exerted by growing crystals may develop large pressures and hence must be considered a factor in vein formation. In these latter papers the explanation given for Bruhns and Mecklenburg's failure to observe an elevation of a load placed on a crystal when an unloaded crystal was growing in the same solution was that the solubility of the loaded crystal was greatly increased by the pressure acting on it, and therefore the degree of supersaturation sufficient for the growth of the unloaded crystal was insufficient to cause growth of the loaded crystal.

We should here distinguish between pressure acting equally on both phases of a system—uniform pressure—and pressure which acts in excess on the solid—non-uniform pressure. The effects are quite different in the two cases, as has been pointed out by Johnston and Adams. The change in solubility produced by uniform pressure is very small as compared to the effect of temperature—1000 atmospheres so applied being equivalent to about 14°. Preliminary experiments on the effect of non-uniform pressure on solubility under carefully controlled conditions indicate that the effect of pressure acting on the solid but not on the liquid is much smaller than that brought about by the same pressure acting uniformly on solid and liquid.

Digitized by Google

Original from
HARVARD UNIVERSITY

Experiments with loaded crystals of potassium alum show that these crystals will lift their loads during growth, even if unloaded crystals are present, as long as the conditions of growth are controlled. The essential point to be considered is that the measure of lifting is the depth of whatever "cavities" may form on the upper or lower surfaces of the loaded crystal. With large crystals these height increments are very small compared to the growth on the top surface of an unloaded crystal and hence were probably overlooked in comparison with the latter. Other factors entering into the lifting effect produced are the relation of load to the crystallographic direction, and the habit of the crystal. The mechanism by which this lifting takes place is not at present known. Taber's view is that the lifting is caused by the expansion which takes place when the solid separates from the film of solution which is assumed to be always under the supporting edge of the crystal. Unfortunately, the experimental difficulties involved in testing this conclusion have not been overcome, so that the matter is unsettled. Another possible explanation is that the lifting effect is an expression of those forces responsible for crystal development. The experimental results obtained with crystals with painted surfaces indicate this explanation.

Discussion: E. T. Wherry described examples of fibrous crystals produced by crystal interference.

J. W. Gidley: *The origin of the mammals.* (No abstract.)

Discussed by R. S. Bassler.

The 315th meeting was held at the Cosmos Club, February 14, 1917.

INFORMAL COMMUNICATIONS

H. E. Merwin: *Diffusion and crystallization of metallic copper in crystalline sulphides.* After cooling from a molten state in a vacuum copper-iron sulphides may contain an excess of copper which slowly diffuses and crystallizes at ordinary temperatures. The growing crystals of copper open cracks in the solid mass in which they form.

REGULAR PROGRAM

D. F. Hewett: *The origin of bentonite and the geologic range of related materials in Bighorn basin, Wyoming.* Bentonite is a drab and cream colored bedded clay which until recently has been recognized only in the upper part of the Benton formation in Colorado, Wyoming, and Montana. Work on the west side of Bighorn Basin has shown that bentonite and clays closely resembling it occur at intervals from the base of the Benton formation of the Colorado group to the top of the Meeteetse formation or upper part of the Montana group. The beds occur, therefore, in a stratigraphic range of about 5500 feet in Bighorn Basin. A clay that closely resembles bentonite is also interbedded with tuffaceous rocks in an upper Eocene formation near Owl Creek.

In order to determine the mineral constituents of bentonite, six specimens were sized by the Bureau of Soils, and the proportions of each of

Digitized by Google Original from HARVARD UNIVERSITY

the more abundant minerals were determined in each size by immersion in oils of known index of refraction. In order that a comparison with bentonite might be made, seventeen specimens of sediment from associated beds were also sized.

Bentonite contains two classes of material. On the one hand, the sands and silt, which include grains that range from 0.005 to 1.0 mm. in diameter, are largely plagioclase (andesine), orthoclase, and biotite, with accessory quartz, glass, apatite, zircon, and agate. The grains of plagioclase and orthoclase are highly angular and are uniformly fresh. Most of the grains of quartz are also angular, but a few are well rounded, whereas the grains of apatite and zircon are fresh terminated crystals. On the other hand, the clay, which includes all grains less than 0.005 mm., shows by analysis water, silica, and alumina. The molecular ratio of silica to alumina is about 9 to 1, and therefore much higher than that in any of the common hydrous silicates of alumina. The dried powder is birefracting (biaxial negative) and the average refringence of different specimens ranges from 1.52 to 1.59. After the clay has been immersed in water, however, it is isotropic and therefore amorphous. This clay forms 73 to 86 per cent of the beds of pure bentonite, whereas the sands and silts make up the remainder. In the beds of impure bentonite however, the proportion of clay is lower and ranges from 54 to 61 per cent. One of the peculiar properties of the clay is its tendency to swell to six or eight times the original volume when immersed in water.

The clays, shales, and sandstones of the adjacent sediments which have been examined, are common types of quartzose sediments. Subangular grains of quartz and chert make up a large part of the coarsest sizes of most of the sediments, but a little orthoclase, biotite, plagioclase, and chlorite are commonly present. Quartz also forms an appreciable part of the finest silt and clay portions, but the birefracting clay of bentonite was not noted in any of the clay portions of these sediments.

In contrast with adjacent sediments, therefore, bentonite contains little if any quartz, but fresh plagioclase, orthoclase, and biotite predominate, and glass is locally present. The comparison of the mineral constituents of bentonite with volcanic ash from several localities, shows that whereas the variety and proportions of the minerals are strikingly similar, the proportion of glass grains in volcanic ash is represented in bentonite by the highly siliceous clay just described. The resemblance in mineralogy and chemical composition of the two classes of materials warrants the conclusion that bentonite is volcanic ash in which the glass has been hydrated and has lost most of its constituents except silica and alumina. An inquiry into the stratigraphic relations of the beds of bentonite appears to show that this alteration must have taken place before the ash was laid down. In the case of the Eocene clays, which are flood-plain deposits, the decomposition took place after deposition.

Digitized by Google

Original from
HARVARD UNIVERSITY

The geologic range of bentonite and the areas within which it is known to exist show that volcanic products probably make up a larger part of the Cretaceous sediments of the region than has been recognized heretofore. Beds of bentonite are present in the Bighorn Basin section, 3000 feet below the horizon equivalent to the base of the Livingstone formation in Montana, which is largely made up of volcanic materials. The source of these volcanic products cannot be determined, but probably is to be found in the region west of eastern Idaho and Utah.

Discussion: C. J. HARES spoke of the distribution and geologic relationships of bentonite. E. T. WHERRY outlined a process by which bentonite is made into a commercially important product for the softening of water. The bentonite is heated and treated with an alkali salt. The resulting material will exchange its alkali for the lime of hard water. F. J. KATZ called attention to the unusual process of alteration involved in the explanation of the origin of bentonite as presented.

FRANK J. KATZ: *Stratigraphy in southwest Maine and southeast New Hampshire.* The following sedimentary formations and groups have been established for the coastal region between the head of Casco Bay, Maine, and southern New Hampshire:

The Berwick gneiss, consisting of highly metamorphosed and recrystallized graywacke, quartzite, and thin micaceous beds, which are developed in a belt 1 to 10 or more miles wide extending southwest from Falmouth and Gorham, Maine, to and beyond Lee, New Hampshire. The formation is of undetermined but probably pre-Cambrian age.

An Algonkian (?) crystalline complex of quartzite, rhyolite, hornblende schist, and graywacke gneisses in Kittery, Maine, and Portsmouth, Newcastle, Rye, and North Hampton, New Hampshire.

The Carboniferous (Pennsylvanian?) Kittery quartzite, a thick formation containing thin-bedded quartzites and argillites in a belt about 10 miles wide along the coast from Saco, Maine, to Portsmouth, New Hampshire, and continuing thence inland in a southwesterly direction to the Merrimack River, where it forms part of the Merrimack quartzite of Massachusetts.

The Eliot slate, the rocks of the Casco Bay group, and the rocks of the Rochester, New Hampshire basin, which are developed in three separate areas but are approximately equivalent and conformably above the Kittery quartzite. Of these the Eliot slate, in Eliot, Maine, and Dover, New Hampshire, and extending thence southwest in two belts, consists of gray sericitic and silicious slates, argillo-quartzitic schists, calcareous beds, and carbonaceous phyllites. The Casco Bay group occupying an area about 12 miles wide and 30 miles long extending along the coast from Saco, Maine, to the head of Casco Bay, consists of the Cape Elizabeth formation of graywacke schists, gray gritty slates, sericite phyllites, and calcareous carbonaceous laminae; the Spring Point greenstone; the Diamond Island slate, a graphitic and pyritiferous quartz slate; the Scarboro phyllite, a carbonaceous sericite phyllite; the Spurwink limestone; the Jewell phyllite; and the Mackworth slate. The

Digitized by Google Original from HARVARD UNIVERSITY

rocks of the Rochester, New Hampshire, basin include the Gonic formation, in a belt 2 to 4 miles wide running from Sanford, Maine, to Barrington, New Hampshire, made up of graywacke schists, mica schists, and garnet-staurolite phyllites; the Rindgemere formation, occupying a broad area in Rochester, New Hampshire, and Acton and Lebanon, Maine, and lying northwest of the Gonic formation, is composed of quartzite, slates, and mica schists, but predominantly of carbonaceous sericite phyllites which contain chiastolite; and the Towow formation, in the town of Lebanon, Maine, and surrounded by the Rindgemere formation, consists of graphitic and pyritiferous quartz slates and carbonaceous sericite phyllite.

The igneous rocks are grouped as: (1) pre-Carboniferous granites, pegmatites, and diorites; (2) late Carboniferous or early post-Carboniferous schistose granodiorites; (3) post-Carboniferous biotite and muscovite-biotite granites, pegmatites, and hornblende diorites; and (4) probably Triassic trap dikes.

The distribution of these rocks was shown on maps on which the rocks of southwestern Maine and southeastern New Hampshire were systematically arranged for the first time. Earlier efforts had resulted only in conflicting petrographic categories without stratigraphic meaning. It is now known that instead of being pre-Cambrian or early Paleozoic rocks, as all had been supposed to be, more than half of the rocks, areally considered, are Carboniferous (Pennsylvanian?) or younger. The other rocks are in part certainly, and the remainder probably, pre-Cambrian.

Discussion: Brooks, La Forge, Paige, Loughlin, Ami, and White called attention to the difficulties in establishing age relations, owing especially to the lack of fossils and to the disturbed and metamorphosed conditions of the rocks. The fact that a very definite trend in the structures had been established was emphasized as establishing relationships with the rocks of eastern Massachusetts.

H. E. Merwin, *Secretary*.

THE BOTANICAL SOCIETY OF WASHINGTON

The 118th regular meeting of the Society was held in the Assembly Hall of the Cosmos Club, at 8 p.m., February 6, 1917; forty-four members and fourteen guests present.

Dr. B. T. Galloway, Mr. Chas. F. Deering, and Prof. W. D. Crocker were elected to membership.

The program of the evening was *The relation of plant succession to forestry and grazing.*

Mr. C. G. Bates stated that foresters were first to apply in a practical way the knowledge of plant succession, and were in a sense the progenitors of this type of ecological science. The natural regeneration of forest stands in each of the climax formations of the Rocky Mountain region was shown to involve succession, there being in nearly all cases temporary control by a sub-climax following the disturb-

Digitized by Google Original from HARVARD UNIVERSITY

ance due to cutting. In practical forest management each formation was shown to present distinct problems in which the kind or degree of cutting is the controlling factor. The correct solution of these problems involves an intimate knowledge of the range of conditions under which the climax type can succeed. Direct seeding of forest trees on ground not recently occupied by the climax forest has usually resulted in failure.

Dr. J. V. Hoffman called attention to the successions in the forests of Washington and Oregon. Two types of succession were distinguished: (1) A type in which the production, distribution, germination of seed, and the establishment of seedlings are important. This type is dependent therefore on the presence of seed trees and progresses into an unoccupied area only 150 to 300 feet during each generation. The resulting forest is composed of trees of uneven age. (2) A type dependent primarily on the viability of seed and in no way dependent on remaining seed trees. The seeds produced by the old stand retain their viability when the forest is destroyed and germinate to form a new forest of the same type and of even-aged trees.

Mr. A. W. Sampson discussed succession as a factor in the management of the range lands of the Forest Service. Succession, or the alternation in the vegetative personnel of an area was found to occur whenever the natural conditions of the environment had been appreciably changed. Where the vegetative cover had been disturbed more or less seriously on pasture and range lands, and the disturbing factors subsequently eliminated or their intensity decreased, the vegetation, through successive invasions, gradually became more like the original.

In the administration of the range on National Forests with a view of maintaining a maximum forage cover, a clear recognition of the successional stages represented by the more conspicuous species is important. Certain species occur early and others late in the succession leading to the development of the climax or ultimate type. The conspicuous appearance of species which occur early and which are usually of little or no value for grazing, shows clearly that the pasture is being improperly used and that a change must be made in the management if the remaining desirable species are to be preserved. Studies of the growth requirements, the life cycles of the more important species, and the successional stages make possible the initiation of systems of management favorable to the invasion and succession of the species desired.

Mr. E. O. Wooton discussed the succession due to protection of a badly overgrazed area on the foothill slopes and adjacent sloping plains of the northwest side of the Santa Rita Mountains in southern Arizona. Quadrat collections were made at various stations at intervals during a period of eleven years. From this data the following successional stages were recognized: (1) Small weedy annuals in spring and annual grasses in summer and fall. (2) Short-lived perennial grasses. (3) Long-lived perennial grasses and a few species of perennial herbs

Digitized by Google Original from HARVARD UNIVERSITY

and very low undershrubs. Succession was most rapid on the upper slopes and the annual and perennial grasses gradually moved down the slopes into drier situations. Fire is the principal factor in preventing shrubs from replacing the grasses.

In the informal discussion Mr. G. A. PEARSON discussed the reseeding of yellow pine areas; Mr. J. T. JARDINE, how to maintain a most productive subclimax type of vegetation for sheep pasturage; Dr. DAVID GRIFFITHS, the effect of fires on the maintenance of the grass stage in Arizona; and Dr. H. L. SHANTZ, the importance of a knowledge of succession in the interpretation of the results of range management.

H. L. SHANTZ, *Corresponding Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 566th meeting of the Society was held in the Assembly Hall of the Cosmos Club Saturday, February 24, 1917; called to order by President Hay at 8 p.m.; 50 persons in attendance.

Under the heading book notices, brief notes, exhibition of specimens, etc., M. W. LYON, JR., called attention to the latest edition of the International Rules of Zoological Nomenclature containing a summary of the opinions that have been rendered by the International Commission, compiled by Mr. John Smallwood of Washington.

Dr. R. W. SHUFELDT communicated a short paper entitled "Notes on the Trunk-fishes" and exhibited a specimen of *Lactophrys tricornis.*

Dr. L. O. HOWARD commented on the parent tree of an unusually fine variety of oranges and the extraordinary care taken of it by the owner during the recent cold weather in Florida.

Mr. WM. PALMER also commented on the effects of the recent "freeze" in Florida.

The regular program consisted of three communications as follows:

T. S. PALMER: *A pioneer naturalist in southern Florida.—Extracts from the diary of Titian R. Peale, 1825.* Dr. Palmer gave a detailed account of Peale's collecting trip in Florida in 1825 made for the purpose of securing birds for Prince Louis Bonaparte and mentioned and exhibited the species of birds discovered by Peale as new to science or new to the United States. He read extracts from Peale's diary and called attention to the other scientific expeditions of which Peale was a member, giving many interesting facts of his long life.

A. L. QUAINTANCE: *Some notes on the Aleyrodidae.* (No abstract.)

EMERSON STRINGHAM (introduced by R. E. Coker): *The shad and its relatives in the Mississippi river.*

Mr. Stringham said that herring-like fishes found in the Mississippi river possess more economic significance than formerly recognized. The two mooneyes (*Hiodon*) have flesh of excellent quality, but they are not sufficiently abundant to be of great importance. They eat principally insects, and feed both summer and winter, day and night, and they deposit their eggs as soon as the water temperature begins to rise in spring. The gizzard shad (*Dorosoma*) which serves as food

Digitized by Google Original from HARVARD UNIVERSITY

for other fishes is less abundant in the Mississippi proper than in slough and lakes. The river herring (*Pomolobus chrysochloris*), known as the host of a mussel of great value, feeds on insects when they are abundant, and on fishes at other times. It breeds early in summer. Fears are entertained that the fish and mussel may be excluded from the upper river by a dam at Keokuk, Iowa. The Ohio shad (*Alosa ohiensis*) seems clearly distinct from the Atlantic shad, but is sufficiently similar to be equally good food, though smaller. On the Mississippi this valuable resource is not utilized. The habits of the fish are similar to those of the Atlantic species, but it has not yet been proved to be anadromous.

M. W. Lyon, Jr., *Recording Secretary.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 508th meeting of the Society was held at the New National Museum on March 6. This meeting was devoted to a general discussion, the subject being *Problems connected with the distribution of the aboriginal population of America.*

Dr. John R. Swanton introduced the discussion by stating that the subject divided itself into a consideration of the distribution of aboriginal population in America quantitatively and qualitatively. "Populations," said Dr. Swanton, "may be classified qualitatively according to their physical characteristics, languages, cultural features, social organization, and so on. Archeology has a bearing on all these." He gave as one of the principal problems to be considered the bearing of the data of each class on the generally admitted Asiatic origin of the American Indians and their diffusion from the northwest.

Dr. Aleš Hrdlička, speaking from the standpoint of physical anthropology, stated that the distribution of different physical types on the American continent has always been in this country one of the main problems of his branch of science. Morton, the father of American anthropology, classified the American Indians in two types: (1) The Toltec, or refined type, which included the Toltecs of Mexico, the Maya, and the mound-builders of the Ohio valley; (2) The Barbarian, which included all the less civilized, semi-nomadic tribes.

This classification, although imperfect, was shown in the course of time to have a good foundation. Roughly speaking we recognize today two great sub-types of the American aborigines which correspond in the main to Morton's groups. The "Toltec" strain shows an irregular but wide distribution over both Americas. Its main areas are portions of the northwest coast, a part of the Pueblo region, a large part of the more southern territory of the "mound-builders," all Yucatan, southern Mexico, Central America, the Antilles, the western region of northern South America, and the coast of Peru, with as yet undetermined areas in Brazil, and traces even farther south. The type is principally marked by brachycephaly. The second Morton group corresponds to the American dolichocephalic population which ex-

Digitized by Google Original from HARVARD UNIVERSITY

tends over vast areas from Labrador and Canada to Tierra del Fuego. Which of these two types is the older on the Continent has not yet been determined. The answer will doubtless differ in different localities. Besides these two, which may be called fundamental physical types of the American population, we now recognize a third group which, though closely related to the first or "Toltec," seems of much more recent introduction and development; this is the Athapascan. A fourth type, also of fairly recent introduction, is the Eskimo. Outside these four strains, all of which are related and proceed probably from one ancient stratum, we have discovered as yet in America no trace of any other Pre-Columbian population.

Dr. Truman Michelson, speaking on the linguistics of the Indians, said, "There is no single type of language, no fundamental structure that is the same in all linguistic stocks, though we find resemblances among them." The speaker stated that resemblances occur between the languages of northeastern Asia and those of certain North American Indians. "An important problem in linguistics," said Dr. Michelson, "is to determine whether resemblances between languages are genetic or borrowed." The distribution of linguistic stocks was indicated on maps.

Prof. William H. Holmes spoke briefly of the probable origin of the human race in southern Asia and the gradual spread from this cradle over wide areas through increase in numbers and intelligence. In passing northward the culture would be gradually modified and on reaching the Arctic it would be reduced to the hunter-fisher state exclusively known throughout the Arctic. In passing to America by the Behring Route migrating groups would carry with them only this single culture stage, but advancing southward changes would take place according to environment. Culture would take on one phase in the Great Plains region, another in the Mississippi Valley, still another in Mexico, and so on; and there would follow interchanges of culture elements between peoples and areas without end. We thus explain the complex conditions and great diversity of the Columbian period.

Dr. J. Walter Fewkes stated that the two great forces which have influenced the distribution of population in North and South America are (1) geographic, the course of migration being somewhat determined by the mountain ranges and rivers, and (2) the food supply, which depended on the climate. Dr. Fewkes called attention to the fact that language does not represent the cultural distribution of a people. Languages shrink and change, but archeology often represents culture in its highest manifestation and affords a permanent basis of study. Thus archeology indicates that two types of people once lived in the southwest. There were two foci of distribution, one in the San Juan valley and the other in the Gila valley. The food quest broadened the outlines of these groups and at the point of juncture there arose a mixed type which we now find along the Little Colorado, while in the original places the culture has entirely disappeared. Dr. Fewkes

Digitized by Google Original from HARVARD UNIVERSITY

spoke of the large and important cultural groups found in the West Indies where the Carib stock was preceded by another stock, the Arawak, both originating in South America. In the West Indes the root of the yuca bears the same relation to the food problem of the people that the corn bears in the southwest.

Dr. Walter Hough said that at the Discovery the tribes of America were identified with the environments in which they had settled and since that time only migrations of a minor character have taken place. The causes of extensive migration were thus conjectural but depended on basic facts of food, transportation, and artificial fire-making.

Mr. Francis La Flesche stated that the ancient rites of the Siouan stock show that the migrations of the people were influenced by the search for food. The first animal mentioned in these rites is the elk, succeeded by the deer, and later by the buffalo, at which period the mention of corn appears for the first time.

Frances Densmore, *Secretary*.

Digitized by Google Original from HARVARD UNIVERSITY

ANNOUNCEMENT OF MEETINGS OF THE ACADEMY AND AFFILIATED SOCIETIES[1]

LECTURES ON HEREDITY

The two remaining lectures of the series on Heredity previously announced by the Washington Academy of Sciences will be given at 8.15 p. m. o'clock, in the Assembly Room of the Cosmos Club, H Street and Madison Place, as follows:

April 13: Prof. W. E. CASTLE: *The rôle of selection in heredity.*

April 26: Dr. ALEXANDER GRAHAM BELL: *The bearing of heredity on human affairs.*

Notices will be sent out before each meeting

Tuesday, April 3: The Anthropological Society, at the New National Museum, room 44, at 4.30 p.m. Program:

LEO J. FRACHTENBERG: *The religious ideas of the northwest coast Indians.*

Tuesday, April 3: The Botanical Society, at the Cosmos Club, at 8 p.m. Program:

HAVEN METCALF: *The control of white pine blister rust* (illustrated). 30 minutes.

R. H. COLLEY: *Technique for the study of the white pine blister rust* (illustrated). 15 minutes.

CHARLES THOM: *Some natural groups in Aspergillus.* 20 minutes.

Saturday, April 7: The Biological Society, at the Cosmos Club, at 8 p.m. Program:

A. S. HITCHCOCK: *Botanizing in the Hawaiian Islands.*

Wednesday, April 11: The Geological Society, at the Cosmos Club, at 8 p.m.

Thursday, April 12: The Chemical Society, at the Cosmos Club, at 8 p.m.

Saturday, April 14: The Philosophical Society, at the Cosmos Club, at 8.15 p.m.

[1] The programs of the meetings of the affiliated societies will appear on this page if sent to the editors by the thirteenth and twenty-seventh day of each month.

Digitized by Google Original from HARVARD UNIVERSITY

CONTENTS

Original Papers

Page

Mathematics.—Note on multiple algebra: The reduction of real dyadics and the classification of real homogeneous strains. Edwin Bidwell Wilson 173

Mineralogy.—Halloysite from Colorado. Esper S. Larsen and Edgar T. Wherry 178

Ornithology.—Diagnosis of a new laniine family of Passeriformes. Harry C. Oberholser 180

Anthropology.—Remarks on terms of relationship. Truman Michelson 181

Abstracts

Geology 185

Phytopathology 187

Proceedings

The Philosophical Society of Washington 189

The Geological Society of Washington 193

The Botanical Society of Washington 199

The Biological Society of Washington 201

The Anthropological Society of Washington 202

Digitized by Google

Original from
HARVARD UNIVERSITY

L. Soc. 120.146. 230. 15

LIBRARY
PEABODY MUSEUM
RECEIVED

NOV 3 1955

Vol. VII

April 19, 1917

No. 8

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

BOARD OF EDITORS

N. Ernest Dorsey
BUREAU OF STANDARDS

Adolph Knopf
GEOLOGICAL SURVEY

A. S. Hitchcock
BUREAU OF PLANT INDUSTRY

PUBLISHED SEMI-MONTHLY
EXCEPT IN JULY, AUGUST, AND SEPTEMBER, WHEN MONTHLY

BY THE

WASHINGTON ACADEMY OF SCIENCES

OFFICE OF PUBLICATION
WILLIAMS & WILKINS COMPANY
BALTIMORE, MD.

Entered as second-class matter July 14, 1911, at the post office at Baltimore, Maryland, under the Act of July 16, 1894

Digitized by Google

Original from
HARVARD UNIVERSITY

Journal of the Washington Academy of Sciences

This JOURNAL, the official organ of the Washington Academy of Sciences, aims to present a brief record of current scientific work in Washington. To this end it publishes: (1) short original papers, written or communicated by members of the Academy; (2) a complete list of references to current scientific articles published in or emanating from Washington; (3) short abstracts of certain of these articles; (4) proceedings and programs of meetings of the Academy and affiliated Societies; (5) notes of events connected with the scientific life of Washington. The JOURNAL is issued semi-monthly, on the fourth and nineteenth of each month, except during the summer when it appears on the nineteenth only. Volumes correspond to calendar years. Prompt publication is an essential feature; a manuscript reaching the editors on the second or the seventeenth of the month will ordinarily appear, on request from the author, in the next issue of the JOURNAL.

Manuscripts may be sent to any member of the Board of Editors; they should be clearly typewritten and in suitable form for printing without essential changes. The editors cannot undertake to do more than correct obvious minor errors. References should appear only as footnotes and should include year of publication.

Illustrations will be used only when necessary and will be confined to text figures or diagrams of simple character. The editors, at their discretion, may call upon an author to defray the cost of his illustrations, although no charge will be made for printing from a suitable cut supplied with the manuscript.

Proof.—In order to facilitate prompt publication no proof will be sent to authors unless requested. It is urged that manuscript be submitted in final form; the editors will exercise due care in seeing that copy is followed.

Authors' Copies and Reprints.—On request the author of an original article will receive gratis ten copies of the number containing his contribution and as many additional copies as he may desire at five cents each. Reprints will be furnished at the following schedule of prices:

	4 pp.	8 pp.	12 pp.	16 pp.
50 copies	$1.08	$1.95	$2.93	$3.80
100 copies	1.30	2.40	3.60	4.70
Additional copies, per 100	.45	.90	1.35	1.70

Covers bearing the name of the author and title of the article, with inclusive pagination and date of issue, will be $2.00 for the first 100. Additional covers $1.00 per 100.

As an author may not see proof, his request for extra copies or reprints should invariably be attached to the first page of his manuscript.

The rate of Subscription per volume is	$6.00*
Semi-monthly numbers	.25
Monthly numbers	.50

Remittances should be made payable to "Washington Academy of Sciences," and addressed to the Treasurer, William Bowie, Coast and Geodetic Survey, Washington, D. C., to Williams & Wilkins Company, 2419–2421 Greenmount Ave., Baltimore, Md., or to the European Agents.

European Agents: William Wesley & Son, 28 Essex St., Strand, London, and Mayer and Müller, Prinz Louis-Ferdinand Str., Berlin.

Exchanges.—The JOURNAL does not exchange with other publications.

Missing Numbers will be replaced without charge, provided that claim is made within thirty days after date of the following issue.

* Volume I, however, from July 19, 1911 to December 19, 1911, will be sent for $3.00. Special rates are given to members of scientific societies affiliated with the Academy.

THE WAVERLY PRESS
BALTIMORE, U. S. A.

Digitized by Google
Original from
HARVARD UNIVERSITY

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

Vol. VII APRIL 19, 1917 No. 8

PHYSICAL CHEMISTRY.—*A convenient form of autoclave.*

George W. Morey, Geophysical Laboratory.

The following form of autoclave has been designed after considerable experience with autoclaves and bombs, and is believed to be superior to commercial forms in ease of construction, in manipulation, and in certainty of closure.

It consists of three parts: a photograph of these separate parts is shown in figure 1, and the assembled autoclave, in cross-section, in figure 2.

The cover, *B*, of the bomb, *D*, is held in place by being pressed against a projecting rim, *A′*, on the outer shell, *A*, by the bolt, *EE*. Following is a detailed description of each part.

The outer shell, *A*, is made from a piece of 4-inch standard pipe. On the upper end a shoulder, *A′*, $\frac{3}{8}$ inch thick, is welded with an oxyacetylene blow-pipe. Near the lower end of the pipe two opposite holes, $1\frac{1}{4}$ inches in diameter, have been drilled; their centers are $6\frac{3}{8}$ inches from the top. These holes are shown in section in figure 2, and are more plainly seen in figure 1.

Inside the outer shell is placed the bomb, *D*. It is made from a piece of $3\frac{1}{2}$-inch standard pipe, one end of which is closed by welding on an iron bottom, as shown. The other end is closed by means of the cover, *B*, the outer rim of which is pressed against the rim, *A′*, on the outer shell.

Special attention should be called to the type of closure. The washer, a ring of 0.8 mm. gold wire, is placed in the space, *C*,

Digitized by Google Original from HARVARD UNIVERSITY

where it is completely surrounded by metal, the sides of the cover being a close fit. This type of closure is the same as that described in a previous paper[1] for closing bombs at high pressures and temperatures. As emphasized therein, it is essential that the washer be completely enclosed by metal, so that when pressure is applied it cannot flow away.

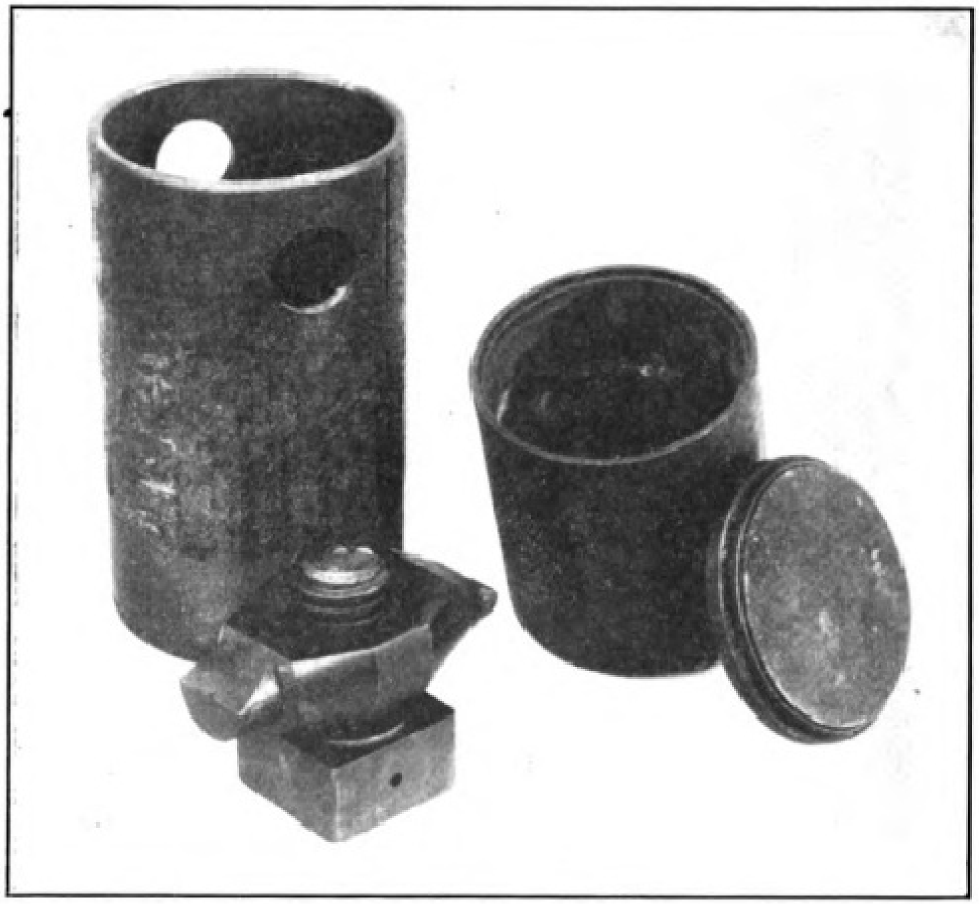


Fig. 1. Photograph of the parts of the autoclave

The cover is held in place by being pressed against the projecting rim of the outer shell by the bolt, *EE*, which is threaded

[1] Morey. Journ. Am. Chem. Soc., **36**: 215–30. 1914; Zeits. anorg. Chem., **86**: 305–24. 1914.

Digitized by Google Original from HARVARD UNIVERSITY

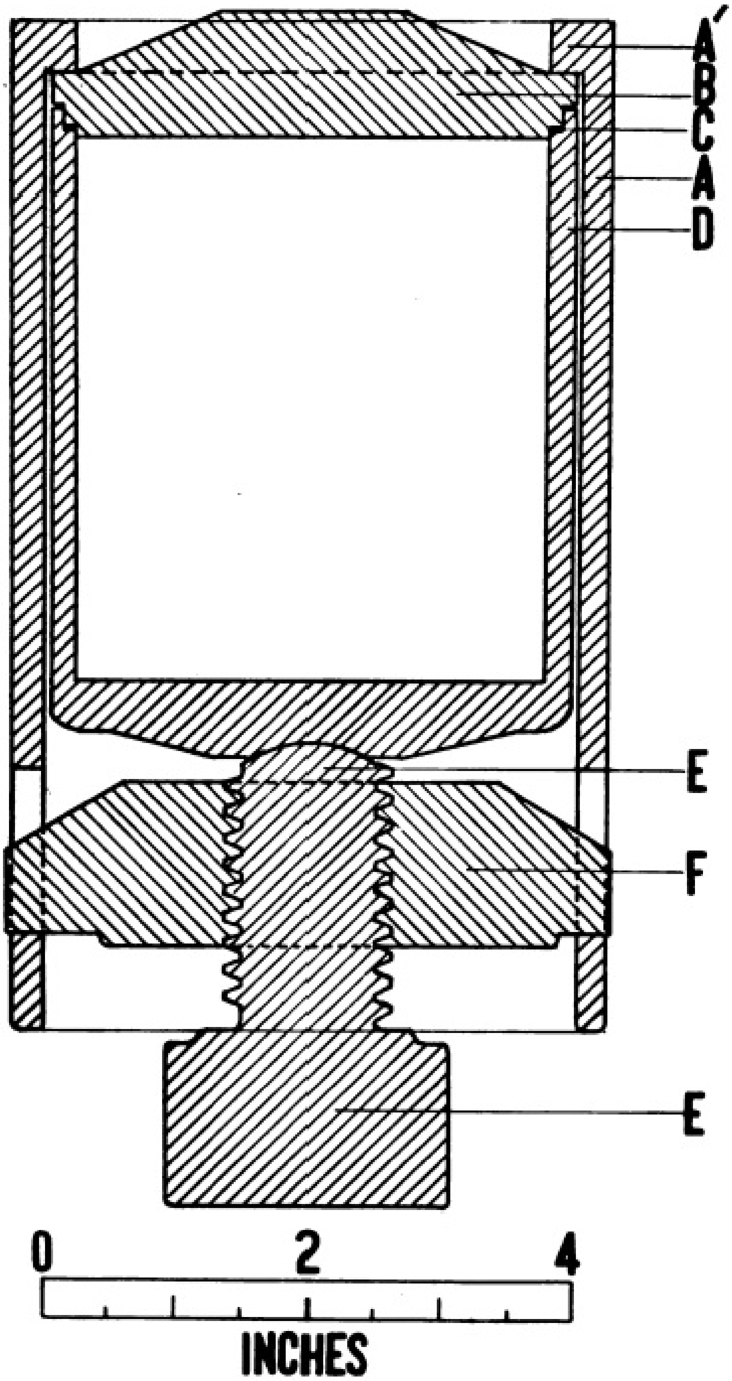


Fig. 2. Cross-section showing the details of the construction and assembling of the autoclave.

Digitized by Google
Original from
HARVARD UNIVERSITY

through the cross-bar, F, in the manner shown. The ends of the cross-bar are semicircular, the arc of the semicircle being downward and pressing against the bottom of the circular hole in the outer shell. When the bolt is turned, its rounded end, turning in the depression in the bottom of the bomb, forces the cover against the rim on the outer shell, thus compressing the gold wire in C, and effecting a tight closure. The ends of the cross-bar are cut away as shown, to enable it to be inserted after the bomb is in place.

The cover shown in the sketch is easily made, and it is convenient to have several for different purposes. Thus, one is provided with an exit tube and valve to permit the escape of the vapor, and another has both an exit tube and a pressure gage.

The above autoclave has been used for many experiments with aqueous solutions at temperatures up to 300° and has given complete satisfaction.

MINERALOGY.—*Leverrierite from Colorado.*[1] ESPER S. LARSEN, Geological Survey, and EDGAR T. WHERRY, National Museum.

Occurrence. During the summer of 1916, in the course of a geologic study of the San Juan Mountains under the direction of Whitman Cross, one of the authors (E. S. L.) collected specimens of a platy, foliated mineral, called "clay-gouge" by the prospectors, in the gold-silver mines of the old mining camp of Beidell, Saguache County, Colorado. The material was in considerable abundance in the dumps of the Buckhorn and Esperanza mines and is reported to occur in irregular bodies up to several feet across. A study in the office has shown it to belong to the leverrierite group of minerals. It is associated with gold and silver-bearing psilomelanite, pyrolusite, and quartz. The pyrolusite is in well-formed prismatic crystals with very perfect cleavages and is probably derived from manganite. The quartz is not abundant and is partly in well-formed crystals, up to an inch or more across, projecting into the

[1] Published with the permission of the Director of the United States Geological Survey and the Secretary of the Smithsonian Institution.

Digitized by Google

Original from
HARVARD UNIVERSITY

leverrierite, and partly of cherty character in coatings and reniform masses attached to the manganese oxides.

Physical properties. The mineral has many of the properties of ordinary "clay-gouge," but it differs in possessing a prominent micaceous cleavage, some of the cleavage pieces being several inches across and commonly bent. When dry it is rather brittle and has a hardness of about 1½. If large fragments are immersed in water they gradually break up, chiefly along the cleavage, into smaller pieces. After soaking for some time the mineral becomes smooth and plastic, and rather sticky. Under the microscope the fragments can be seen, however, to have retained their optical properties. On kneading the plastic mass the fragments are broken up, but still retain their properties. The plasticity can not be accounted for on the basis of the presence of any colloidal material, but seems rather to be due to the superposition of innumerable minute, soft, flexible plates, separated by films of water. The Colorado leverrierite has a vitreous luster and waxy appearance, and varies in color from nearly colorless to dark olive-buff (Ridgway 21‴) or russet-vinaceous (Ridgway 9‴).

Optica properties. A microscopic examination of a number of specimens showed them all to be essentially identical. The pale russet-vinaceous specimen selected for analysis is in bent plates up to an inch across, and appears to be homogeneous. The acute bisectrix is normal to the plates, the axial angle is sensibly 0, and the mineral is optically negative. The indices of refraction were measured by the immersion method. Fragments immersed in mixtures of clove oil and petroleum oil and quickly compared with the oil gave apparent values of $\alpha = 1.470 \pm 0.005$, β and $\gamma = 1.515 \pm 0.005$, but on standing in the oils the indices of refraction slowly increased. After standing for two days in mixtures of clove oil and cinnamon oil they reached a maximum constant value and matched the liquids in which they were imbedded with values of $\alpha = 1.558 \pm 0.003$, β and $\gamma = 1.602 \pm 0.003$. On removing the fragments from the liquid that had stood and placing them in a fresh liquid of the same index they still matched.

Digitized by Google Original from HARVARD UNIVERSITY

A similar change in the apparent indices of refraction, as measured by the immersion method, has been noticed in a number of other minerals. In some it is clearly due to the fact that the mineral has submicroscopic pores and that the apparent index of refraction is the result of the combined effects of the mineral and gas or water filling the pores; but if the pores are filled with a liquid having the same index of refraction as the mineral, the true index of the mineral can be measured.[2] For instance, the halloysite ("isotropic kaolinite")[3] from Wagon-Wheel Gap, Colorado, is clouded when first immersed, and the liquid can be seen to penetrate the grains, making them clear and increasing their index of refraction. The pores in the leverrierite are submicroscopic and the mineral appears clear, but the penetration of the liquid can be followed by the change in index of refraction in a zone from the border inwards.

Chemical properties. Qualitative examination having shown the material to be a hydrous aluminium silicate, it was analyzed quantitatively in the laboratory of the National Museum. The behavior of the water proved to be rather peculiar, so its relation to the optical properties of the mineral was studied first.

Behavior of the water. It is customary in mineral analysis nowadays to determine water of two kinds. That given off by heating to 105° or 110° is recorded as H_2O-, and that given off above one of these temperatures is recorded as H_2O+. This represents a decided advance over the older plans of determining only total water, or of drying the sample at 110° before weighing it out for analysis, and for many purposes may be adequate. But our knowledge of hydrous colloidal minerals, and even of many containing water of crystallization, will never be complete unless the actual temperature ranges over which the water is liberated both above and below 110° are recorded. While the boiling point of pure liquid water under a pressure of one atmosphere is 100°, the water held by a solid, even though not chemically combined in the strictest sense, may vaporize at a far lower

[2] Surface tension and similar phenomena may modify this.

[3] Larsen, E. S., and Wells, R. C. *Some minerals from the fluorite barite vein near Wagon-Wheel Gap, Colorado.* Proc. Nat. Acad. Sci., **2**: 364. 1916.

Digitized by Google

Original from
HARVARD UNIVERSITY

temperature than this, and again may be given off only at a much higher temperature.

In the case of the mineral here described the temperature of 100° possesses no significance whatever, as is clearly shown by Table 1, in which the loss at different temperatures is recorded. The coarsely powdered mineral was heated to each temperature in a covered platinum capsule for 2 hours.

TABLE 1

LOSS OF WATER FROM LEVERRIERITE FROM COLORADO

TEMP. °C	PER CENT H_2O LOST		TEMP. °C	PER CENT H_2O LOST	
20	Start		120	0.05	
30	2.05		130	0.05	
40	1.85		140	0.20	
50	2.10		150	0.35	
60	0.75		160	0.25	
70	0.45	Total below 110°, 10.75 per cent	170	0.25	
80	1.15		180	0.35	Total above 110°, 6.65 per cent
90	1.60		190	0.30	
100	0.45		200	0.35	
110	0.25		250	0.45	
			300	0.60	
			350±	3.15	
			ign.	0.30	Total water, 17.40 per cent

In interpreting the results it must be borne in mind that the amount of water lost at a given temperature depends on the fineness of grinding, the length of heating, the humidity of the atmosphere in which the heating is done, etc., so that too great significance should not be attached to such data. It is worth noting, however, that over one-third of the total water is given off below 50°, and nearly two-thirds below 110°. Nearly all the water is lost below 350°. By way of contrast it may be mentioned that a sample of halloysite recently studied by us[4] retained 12.9 per cent of H_2O at 400°.

[4] LARSEN, E. S., and WHERRY, E. T. *Halloysite from Colorado.* Journ. Wash. Acad. Sci., 7: 178. 1917.

Digitized by Google

Original from HARVARD UNIVERSITY

Effect of dehydration on the optical properties. In order to determine the effect of dehydration on the crystal structure, samples of coarse powder were examined microscopically after being heated respectively for 8 hours at 65°, 5 hours at 130°, 2 hours at 290°, and 2½ hours at 360°. The loss of so large an amount of water would lead one to expect considerable change in the properties. However, the optical properties remained

TABLE 2

EFFECT OF DEHYDRATION ON THE OPTICAL PROPERTIES OF LEVERRIERITE FROM COLORADO

TEMP. °C.	PER CENT H_2O	β and γ	α	APPARENT[a]		REMARKS
				β and γ	α	
20	17.4	1.602	1.558	1.515	1.470	Indices of refraction of grains immersed in oils appear to increase for several days before reaching the maximum value
75	10.0	1.600	1.555	1.495	1.46	Reaches maximum value in a short time
130	6.5	1.597	1.553	....	....	Quickly increases to maximum value
290	3.7	1.600	1.555	....	....	Quick'y increases to maximum value
360	0.2	1.603	1.559	....	....	Quickly increases to maximum value
Redness	0.0	1.54 varies ±0.03	1.50 varies	1.54	.....	Contains clouded areas. Rather deeply colored and pleochroic

[a] The apparent value as measured by the immersion method immediately after imbedding in an oil of that index of refraction.

practically unchanged up to 360°C, and there was only a moderate decrease in the indices after heating for half an hour at redness. The results are presented in Table 2. The mineral remains sensibly uniaxial, even after heating to redness, and the optic axis emerges normal to the plates. On heating, it gradually loses its waxy luster and becomes somewhat darker in color and more strongly pleochroic. It increases in hardness slightly and becomes rather brittle. The perfect cleavage becomes even more prominent than before dehydrating.

Digitized by Google
Original from HARVARD UNIVERSITY

No satisfactory interpretation of this remarkable constancy of optical properties with wide difference in H_2O content occurs to the authors. The loss of water of crystallization or of chemically combined H_2O should have a considerable influence on the optical properties and would be expected to be accompanied with a complete change in all the crystal properties. Even the loss

TABLE 3

ANALYSES OF MINERALS OF THE LEVERRIERITE GROUP

	1	2	3	3a	4	5	6	7	8
SiO_2	47.28	47.84	47.56	789	47.95	49.90	50.55	49.4	48.43
Al_2O_3	20.27	20.88	20.57	256	32.67	37.02	19.15	45.1	41.63
Fe_2O_3	8.68	8.48	8.58		0.23	3.65			
MnO		0.24	0.24				4.40		
CaO	2.75	2.52	2.52	89	0.41	tr.	0.63		
MgO	0.70	0.91	0.80		0.46	0.30			2.13
Na_2O	0.97	1.58	1.28		2.47				
K_2O	tr.	tr.			0.24	1.13			
H_2O+	19.72	6.65	6.65		7.03	8.65	24.05	5.6	7.70
H_2O-		10.95	12.01		8.56	?		?	?
Totals	100.37	100.05	100.21		99.36	100.65	98.78	100.1	99.89
$Al_2O_3 : SiO_2$			1:2.76		1:2.34	1:2.11	1:3.95	1:1.86	1:1.94

1 and 2. Material from Beidell, Colorado. New analyses by E. T. W.

3. Average of 1 and 2.

3 a. Molecular proportions of 3.

4. Average of 2 analyses of "rectorite," Garland County, Arkansas. Brackett, R. N., and Williams, J. F., Amer. Journ. Sci., **42**: 16. 1891.

5. Leverrierite, Rochelle, France. Termier, P., Bull. Soc. Min., **22**: 29. 1899. Analysis made on material dried at 110°–130°. Older analyses show 13.21 and 18.0% of total water.

6. "Montmorillonite, var. delanouite," Millac, France. Quoted from Lacroix, A., Mineralogie de la France.

7. "Batchelorite," Tasmania. H_2O stated as "combined H_2O." Gregory, J. W., Trans. Austr. Inst. Min. Eng., **10**: 187, 1905.

8. Kryptotile. Quoted from Dana. The original article reports H_2O without a statement as to whether it represents total water or water above 100°.

of 17.4 per cent of "absorbed" H_2O would be expected to cause a considerable change in the values of the indices of refraction.

Composition. Two different samples shown by microscopic examination to be essentially homogeneous were analyzed by standard methods and yielded the results shown in columns 1

Digitized by Google Original from HARVARD UNIVERSITY

and 2 of Table 3; columns 4 to 8 give analyses of other members of the same group of minerals for comparison. The name leverrierite has been selected for the group because it has priority over all the others except kryptotile, which is, however, only known in indefinite mixtures.

All the minerals shown in the table are essentially silicates of aluminium with some Fe_2O_3 and RO. Assuming that the Fe_2O_3 and RO replace Al_2O_3, the ratio $Al_2O_3 : SiO_2$ varies from 1.86 to 3.95. The H_2O+ and the total H_2O also vary considerably, but no more than might be expected from determinations made under widely different conditions. Kryptotile is reported as having 7.70 per cent of H_2O. If this represents total water, it contains considerably less than the others. Batchelorite, kryptotile, rectorite, and the original leverrierite are near to $Al_2O_3.2SiO_2.2H_2O$ in which about half the H_2O is given off below 110°. The Colorado mineral is nearer to $Al_2O_3.3SiO_2.4H_2O$ and about two-thirds of the water is given off below 110°; while delanouite is near $Al_2O_3.4SiO_2.6H_2O$. However, there appears to be an almost continuous variation of the ratio $Al_2O_3 : SiO_2$ from 1.86 to at least 2.76. This can hardly be due to admixed impurities, as the authors have examined the Colorado mineral and the type rectorite, and have found them essentially homogeneous, and the descriptions of the analyzed leverrierite and batchelorite also indicate homogeneous material, although the delanouite examined by the authors contained some impurity while the description of the analyzed kryptotile indicates impure material. This variableness in composition within definite limits suggests that a mineral group is represented, or at least a species including several subspecies, as is the case, for instance, with muscovite. This view is confirmed by a comparison of the properties of the several minerals in Table 4.

The optical and physical properties of the six minerals, while not identical, are about as nearly alike as are the corresponding data for various specimens of muscovite and other complex minerals; and as in muscovite, the cleavage, optic orientation, optic character, and birefringence show comparatively little variation, while the axial angle and indices of refraction vary

Digitized by Google Original from HARVARD UNIVERSITY

within moderate limits. This similarity, together with the continuous variation in chemical composition, shows with reasonable certainty that all the minerals are members of a continuous

TABLE 4

PROPERTIES OF LEVERRIERITE AND RELATED MINERALS

	RATIO Al_2O_3: SiO_2	OPTICAL ORIENTATION	2V	α	β	γ	REMARKS
Batchelorite	1:1.86	....	....	.....	.....	.....	Foliated
Kryptotile[a]	1:1.94	X ⊥ cleav.	0–45°	1.558	1.593	1.594	Fibrous, platy
Leverrierite[b] France	1:2.11	X ⊥ cleav.	0–50°	1.554	1.582	1.582	Vermicular, micaceous
Rectorite[c], Arkansas	1:2.34	X ⊥ cleav.	38° ±	1.550	1.588	1.590	White, dull, tough. Resembles mountain leather. Interwoven fibers and plates. Rather plastic when wet
Material from Colorado	1:2.76	X ⊥ cleav.	0°	1.558	1.602	1.602	Luster vitreous to waxy, rather brittle. Platy. Very plastic when wet
Delanouite[d]	1:3.95	X ⊥ plates	Small	1.54	1.570	1.570	Not entirely homogeneous. Feathery plates

[a] New data on specimen from Waldheim, Saxony, kindly furnished by Colonel Roebling. The material closely resembles sericite.

[b] Published data of Wallerant. Other data gives the birefringence as low as 0.008.

[c] New data from U. S. Nat. Mus. specimen No. 80607. The indices vary. When first measured $\alpha = 1.500$, $\beta = 1.541$, $\gamma = 1.543$. The indices appear to increase on standing in oils. (Cf. the Colorado mineral.)

[d] New data on "montmorillonite, Millac." Specimen kindly furnished by Prof. A. Lacroix. A red, clay-like mineral. Under the microscope it is seen to be made up of rather coarse, feathery plates or fibers. The best interference figures show that the mineral is optically negative and has a small axial angle. Some fibers are optically positive and have a large axial angle.

series with varying proportions of SiO_2 and Al_2O_3. This would not require any greater variation in the chemical composition than that due to the change in the water content, which, as was

Digitized by Google Original from HARVARD UNIVERSITY

pointed out above, takes place without a break in the crystal structure, as shown by the optical properties. Muscovite and other micas (to which leverrierite is probably related), show almost as wide a range in the ratio between the SiO_2 and Al_2O_3, as leverrierite; they also show like the latter but small variations in their optical properties.

Leverrierite and some of the minerals here united with it have usually been included in text books on mineralogy as varieties of kaolinite. However, Termier[5] has shown that it is undoubtedly a distinct mineral. He concluded that it is a muscovite in which the K_2O is replaced by H_2O, but since this conclusion is based on an analysis of the mineral dried at 110° it seems hardly justified; yet the cleavage and optical properties are certainly near those of the mica group, to which the leverrierite group is believed to be closely related.

Chemically it differs from kaolinite, chiefly in the fact that it retains only 7 per cent of its H_2O at 110° and very little at 350°, while kaolinite retains nearly all of its 14 per cent of H_2O up to 400 degrees. Optically leverrierite has higher indices of refraction, much stronger birefringence, and much smaller axial angle than kaolinite, and it is commonly found in larger plates.

The leverrierite group includes then, the micaceous hydrous silicates of aluminium with small amounts of Fe_2O_3, RO, and R_2O, in which the ratio Al_2O_3: SiO_2 varies at least from 1.85 to 3.95; the H_2O content under normal conditions is from 15 to 24 per cent, of which all but about 7 per cent is given off below 110°. In physical and optical properties leverrierite resembles muscovite, but its cleavage is less prominent, it is rather brittle when dry and very plastic when wet, and its axial angle is commonly very small.

Summary. Leverrierite occurs in the veins of quartz and manganese oxide at Beidell, Saguache County, Colorado, in cleavage plates up to several inches across. It has a very perfect basal cleavage. It becomes plastic when wet. It is optically negative, practically uniaxial, and the optic axis emerges sensibly normal to the cleavage. The indices of refraction as

[5] TERMIER, P. Bull. Soc. Min., **22**: 27. 1899.

Digitized by Google Original from HARVARD UNIVERSITY

measured by the immersion method, immediately after imbedding in a liquid, appear to be $\alpha = 1.470$, β and $\gamma = 1.515$, but on standing in an immersion medium the liquid slowly penetrates the grains, probably displacing air and possibly some water, and after remaining several days in the liquids β and γ of the grains match a liquid with an index of refraction of 1.602, and α, one with an index of 1.558. These are believed to be the indices of refraction of the mineral. Loss of water, even to the extent of 17 per cent, causes no appreciable change in the optical properties, except a deepening of the color.

A chemical analysis of the mineral is given and the loss of H_2O at different temperatures. This analysis and analyses of rectorite, leverrierite, batchelorite, kryptotile, and delanouite are compared, and show some variation in the water content and, more especially, in the SiO_2: Al_2O_3 ratio, which varies from 1.86 in batchelorite to 3.95 in delanouite. However, optical study of the six minerals indicates that they belong to a single group, probably related to the micas. Analyses of muscovite show almost as wide a range in the SiO_2: Al_2O_3 ratio. The formula of the leverrierite group may be written $Al_2O_3.2 \pm SiO_2.2\frac{1}{2} \pm H_2O$.

MEDICAL ZOOLOGY.—*The carriage of disease by insects.*[1] L. O. Howard, Bureau of Entomology.

In his opening remarks the speaker called attention to the fact that the whole great field of the carriage of disease by insects has been developed within the last twenty years. He showed that in the standard medical works of twenty years ago, such as for example the 1895 edition of Osler's *Principles and Practice of Medicine*, there occurs absolutely no mention of insects in connection with the etiology of disease, either of man or of the higher animals; yet at the same time he showed that as early as 1889 Theobald Smith had discovered the causative organism of the so-called Texas fever of cattle (*Babesia bovis*) and that with the experimental aid of F. L. Kilbourne he had

[1] Address as retiring President of the Washington Academy of Sciences, delivered February 1, 1917. Abridged by the author.

Digitized by Google Original from HARVARD UNIVERSITY

shown that this organism was carried from southern cattle to non-immune cattle by the so-called southern cattle tick (*Margaropus annulatus*), the results of this experimental work having been published in 1893.

Even before this, however, Dr. Patrick Manson, now Sir Patrick Manson, had demonstrated the carriage of the parasitic worm, *Filaria nocturna*, responsible for certain of the diseases grouped under the name filariasis, from mosquitoes to man. Manson's discovery was, however, by no means so significant as that of Theobald Smith. The announcement of Smith's discovery, however, coming from a veterinary service and published in the annual report of the Department of Agriculture, unfortunately received little attention from the scientific world in general.

The initial discovery which attracted world-wide attention was that of Ronald Ross in India, who found that malaria is carried by certain mosquitoes.

The speaker here digressed in order to give his views concerning the recently agitated theory of the transmission of infantile paralysis by insects. He said:

The whole country was interested and alarmed at the occurrence of an unusual number of cases of infantile paralysis during the past summer (23,970 in all, with 2072 deaths out of a total of 7925 cases in New York City alone), and many theories were advanced concerning its method of spread. I must confess that when it was announced that the causative organism had been found in the intestinal passages as well as elsewhere and that it probably enters the body of the patient through the mucous membrane of the mouth and nose, I instantly thought of the house fly and the all too frequent contamination of exposed food by this insect, frequently fresh from intestinal discharges. But a second thought showed me that were such a method of conveyance of the disease possible the disease itself would be much more common and there would have been last summer very many thousands rather than many hundreds of cases. Then too, the not infrequent winter cases could not very well be fly-borne.

Mosquitoes have been suggested as carriers, and a well reasoned paper by Dr. Mark W. Richardson, of Boston, was published last September under the title "The Rat and Infantile Paralysis," the rat-flea of course being the theoretical carrier. But rat-fleas go to human beings only in the event of epidemic disease among rats, and nothing of the sort has been noted in connection with any of the larger epidemics of infantile paralysis.

Digitized by Google Original from HARVARD UNIVERSITY

Moreover in inoculation experiments reported by Flexner and Lewis, the virus is present in the blood of inoculated monkeys in such high dilution that the infection in a normal animal is accomplished only by inoculation of 20 cc. or more of the blood. If this holds under normal conditions, it becomes absurd to accuse any biting insect of the carriage of this particular disease, except in the possible event of the development of the organism in the body of the insect. While this possibility should be studied, the probabilities are against it. The impression which all of us in Doctor Flexner's audience at his lecture given December 28, in New York, gained, was I think that we are still greatly in the dark in regard to this disease, but that possible insect carriage must probably be ruled out.

It was then shown that it is necessary to divide the field under discussion into three categories.

1. Insects as simple carriers of disease, the accidental carriers as it were; that is, insects frequenting places where disease germs are likely to occur and conveying these in their stomachs or on their bodies to food supplies. This is notably illustrated by the house fly.

2. Insects as direct inoculators of disease. These are biting insects which feed upon diseased men or animals and carry the causative organisms on their beaks and insert them into the circulation of healthy animals. In this way anthrax is carried by biting flies; surra is carried in the same way, as is also the nagana or tsetse-fly disease of cattle. So also is bubonic plague carried in this manner by rat-fleas, but here there is more than a passive carriage, as is also the case with the tsetse-fly disease.

3. The third category, and this is perhaps the most important, includes insects as essential hosts of pathogenic organisms. These are the cases in which the parasitic organism undergoes its sexual generation in the body of its insect host and another, non-sexual, generation or generations in its warm-blooded host. To this class belong the malarial mosquitoes, the yellow-fever mosquito, and the rapidly increasing number of species that carry trypanomiases, leishmanioses, spirochaetoses, and the ticks that carry relapsing fevers and other fevers of man and animals, and the lice that carry typhus fever.

Under the first of these three categories the house fly was considered at some length, and cockroaches, ants (especially

Digitized by Google Original from HARVARD UNIVERSITY

the household ant), the latrine fly (*Fannia scalaris*), and other insects were mentioned rather incidentally.

Under the second category the biting flies that carry anthrax were mentioned, and illustrated (as, in fact, was the entire address) by lantern slides. Under this head also, carriage of bubonic plague by rat-fleas was discussed at some length.

Under the third category, insects as essential hosts of pathogenic organisms, attention was called to certain tapeworms which have alternate hosts in insects or other arthropods and domestic animals, especial mention being made of *Hymenolepis diminuata* which lives commonly in the intestines of rats and mice and has as its alternate hosts certain insects which feed in meal, so that man may become affected by eating dejecta of such insects in dirty cereals. The carriage of *Filaria nocturna* by *Culex fatigans* (*quinquefasciatus*), and Ransom's discovery of the house fly parasite *Habronema muscae* as a stomach parasite of the horse, and the pig parasite (*Echinorynchus gigas*) sometimes occurring in man, with its alternate hosts as the larvae of cockchafers in Europe and the common white grubs (larvae of Lachnosterna) in the United States, were described.

Then followed a longer consideration of mosquitoes and malaria, and mosquitoes and yellow fever.

Under the head of trypanomiases, the carriage of the nagana of African cattle by *Glossina morsitans* and the sleeping sickness of Africa carried by *Glossina palpalis* were mentioned, as well as the wasting disease of children in Brazil known as opilacao, caused by *Trypanosoma cruzii* and possessing a definitive host in the large biting true bug *Conorhinus megistus*

Then followed a consideration of insects and leishmanioses, ticks and spirochaetoses, including some detailed account of ticks and the Rocky Mountain spotted fever. A fuller consideration was given to typhus fever and lice.

Stating that the carriage of typhus fever by the body-louse was first demonstrated by Ricketts in the City of Mexico, where this discoverer lost his life from this fever in the course of his investigations, mention was made of the tremendous death rate from this disease during the last Balkan war in Serbia and

Digitized by Google

Original from
HARVARD UNIVERSITY

its destructive appearance in many places during the present great war. It was shown that at first the information put out by the medical departments of the different armies was insufficient and in many cases illy based. Especial mention was made of the publications issued in England, France, and Germany, the extraordinarily detailed observations by Haase, made in Germany in the camps of Russian prisoners, receiving special consideration. He showed that more recently an intense investigation has been carried on in many places of all of the aspects of the biology of the body-louse. He showed that in the current number of the *Bulletin of the Pasteur Institute of Paris* (December 15, 1916) reviews had been found of seventeen papers, under the heading La Lutte Contre les Puces. One of these was written by a Japanese, four by Englishmen, seven by Germans, one by a Swiss, two by Frenchmen, one by a Russian, and one by an Italian. He pointed out especially the very perfect proof adduced in one of these articles of the transportation by wind of the body-louse, a very important point to be considered in sanitary measures.

In concluding, the speaker referred to a manuscript table drawn up by Mr. W. D. Pierce from the recent literature, which indicates that discoveries have been recorded of 226 different disease organisms as carried by insects to man or animals; that 87 organisms are known to be parasitic in insects but not known to be transmitted, and that 282 species of insects are recorded as causers or carriers of diseases of man or animals.

The concluding paragraphs of the address are quoted:

But now we must stop. There are many subjects in the field which we have not touched. Tick paralysis, for example, is a most interesting and novel subject. This disease occurs in Australia, Africa, and North America. In Oregon thirteen cases have been found in the practice of a single physician. The attachment of a tick brings about progressive paralysis involving motor but not sensory nerves. It seems a unique malady. Hadwen and Nuttall, showing that it is not infectious and that there is apparently an incubating period in the tick, suggest a specific causative organism, but others hold to the theory of nerve shock.

Attention should also be called to the fact that, in spite of the host of discoveries already well established, there is a dangerous tendency

Digitized by Google Original from HARVARD UNIVERSITY

to exaggerate the importance of insect transmission, and to overlook, even in cases where insects may occasionally be concerned, the greater importance of other modes of infection. This is indicated by Sambon's theory of transmission of pellagra by Simulium—a theory which was advanced with enthusiasm on the ground that it fitted into the known facts in the epidemiology of the disease. It took two years of hard work on the part of members of the force of the Bureau of Entomology, working in collaboration with the Thompson-McFadden Pellagra Commission, to upset this theory in a thoroughly scientific manner. As has been pointed out several times of late, there is always considerable danger in conclusions based on epidemiological findings. Transmission experiments are necessary.

One conclusion must be drawn which can hardly be disputed: There is an enormous field for the entomologist in the careful study of all of the aspects of the biology of not only those insects which have already been shown to be disease carriers but of those which are likely to be implicated. It is to the trained economic entomologist that we must look for the methods of destruction of these insect carriers, and the prevention of this class of diseases lies at his door rather than at that of the physician. Either that, or sanitarians must be trained in what is now known as medical entomology.

ETHNOLOGY.—*Remarks on American Indian languages, a study in method.*[1] TRUMAN MICHELSON, Bureau of American Ethnology.

At the very beginning of this subject it should be stated that there is no single type of speech which holds good for all American Indian languages. The statement that all American Indian languages are both polysynthetic and incorporative, so confidently affirmed by the older writers, is false. The number of American Indian languages that are either polysynthetic or incorporative, is extremely limited indeed. I do not know of a single feature that may be said to be characteristic of all American Indian languages. Even so, a combination of certain features is quite sufficient to determine whether any given language is an American Indian language or not. It is this which enables us to say without any hesitation that Chuckchee, Koryak, and Yukaghir (which are spoken in northeastern Asia) are Americanoid languages. If they were spoken in America we would call them American Indian languages. They do not belong geneti-

[1] Printed with the permission of the Secretary of the Smithsonian Institution.

Digitized by Google

Original from HARVARD UNIVERSITY

cally (as far as is known) to any American linguistic stocks, but nevertheless the totality of their features compels us to classify them with American Indian languages. To account for these facts we must assume either that these tribes are the descendants of the forefathers of American Indians who did not follow their brethren in the migration from Asia to America (for such a migration is firmly established by the facts of physical anthropology), or that there has been in comparatively recent times a migration backward from this continent to Asia. In as much as the bulk of American Indian languages are spoken on this continent, from a purely linguistic point of view the latter hypothesis is the most probable. But the essential fact in any case will remain unchallenged, namely, that we have Americanoid languages spoken in northeastern Asia.

Let us now turn to the almost unparalleled number of linguistic stocks on this continent. We have an apparent anomaly as compared with most parts of the world. The point at issue is whether such a multiplicity of stocks is original or not. In the first place, in the study of American Indian languages we are at a decided disadvantage as compared with the study, say, of Indo-European languages. Suppose that modern English and modern Russian were the sole survivors of the entire stock. It would be impossible to prove absolutely that they were both genetically descended from a common ancestor, no matter what we might surmise. It is only because we have continuous written records of both covering several centuries, and have the aid of other related languages which have even earlier records, that we can absolutely prove this. For this reason it is clear that there always will be American Indian languages whose genetic connection we may suspect, but which we can not prove. It may be urged that we can actually see what has taken place in the development and differentiation of languages which have been historically transmitted, such as Indo-European languages, and that we should apply the principles derived from such a study to American Indian languages in determining the stocks. The methodical error in such a procedure lies in this, namely, that there are less than a half a dozen, different stocks in

Digitized by Google Original from HARVARD UNIVERSITY

the entire world of which we have records going back continuously for more than a thousand years. The percentage of the total stocks so transmitted is altogether too small to afford a firm and sure foundation for such a mode of action. If we could establish from a minute study of the dialects of some dozens of stocks that the kind of differentiation, etc., was on the whole of a similar nature in these stocks, we would be entirely justified in applying the principles derived from such a study to the determination of the limits of stocks in American Indian languages and other stocks as well. Unfortunately such a study has not been made, nor is there any prospect of it being done in the immediate future.

We have a similar difficulty in the reconstruction of parent-languages of American Indian linguistic stocks. In the case of Indo-European languages we again can take advantage of principles derived from a study of the historical development of the separate members of the stock, and apply the results to the prehistoric period. We can not do this in the case of American Indian languages. The nearest approach to this would be a very minute study of the dialects of known stocks. In some cases there is no doubt that this would even largely counterbalance the difficulty spoken of. For example, most of the dialects of the Algonquian stock are so closely related that it can readily be ascertained in at least many cases what is archaic and what is secondary. Thus it is certain that the Fox *e* and *i* vowels are more primitive than the Ojibwa *i* vowel, and that the terminal vowels preserved in Fox, Sauk, Kickapoo, Shawnee, and Peoria, but not appearing in Ojibwa, Ottawa, Potawatomi, etc., are archiac.[2] Hence these features are to be ascribed to the Algonquian parent language. However, we can not know that precise quality of the prehistoric *e* and *i* vowels. Similarly the combination of a sibilant followed by a surd stop in Cree is more archaic than the correspondents in many of the related languages, and so is to be likewise ascribed to the parent language. (The actual proof that the Cree combination is more

[2] Amer. Anthrop. N. S., **15**: 470. 1913; this JOURNAL, **4**: 403. 1914; Ann. Rep. Bur. Amer. Ethnol., **28**: 247. 1912.

Digitized by Google Original from HARVARD UNIVERSITY

archaic is too complicated to be given here, as it would of necessity be altogether disproportionate to the length of this paper.) Naturally, in some instances, absolute proof would be wanting. Thus in certain cases Ojibwa *nd* corresponds to Cree and Menominee *'t*, Fox *t*. It can be easily shown that the Fox *t* in this case is in all probability unoriginal; and most philologists will assume that Ojibwa *nd* is more archaic than Cree and Menominee *'t*. But probability and assumption are not the same as proof.

A further obstacle to the reconstruction of the parent languages of American Indian stocks is our frequent inability to formulate phonetic laws in a manner such as is demanded by all modern Indo-European philologists. These contend that phonetic laws in themselves admit of no exceptions; and that wherever we find apparent exceptions, there is some extraneous reason, or reasons. The historical study of the individual Indo-European languages shows that analogy and the like have been potent factors in transforming them, and are fully as important as the actions of phonetic laws. For example late Latin *potēbam* is not a phonetic transformation of Latin *poteram*, but is due to the influence of other imperfects in *bam* preceded by a long vowel. For this reason we are justified in extending the principles derived in this manner to the prehistoric period, to harmonize discrepancies among the historical languages which cannot be accounted for by phonetic laws. Thus the Italic languages have an ablative singular of *ā* stems in *ād* (retained in Oscan and early Latin; final *d* lost in classical Latin by phonetic law). The collective study of Indo-European languages shows conclusively that the ablative singular of *ā* stems was the same in form as the genitive. Since the same study demonstrates that *o* stems in the Indo-European parent language had an ablative singular in *ōd* (preserved in early Latin; *d* lost phonetically in classical Latin), and that no other stems in the Indo-European parent language had a special case form for the ablative singular; and since we know that in historical Indo-European languages analogy has been a potent transforming factor, we have an entirely legitimate right to assume that the Italic languages developed an *ād* abla-

Digitized by Google Original from HARVARD UNIVERSITY

tive singular for *ā* stems by the influence of the *ōd* ablative singular of *o* stems. In one sense the proof is not absolute, but it is as absolute as it is possible to give when dealing with prehistoric phenomena. It must be admitted that at times even Indo-European philology is at sea, and that pure'y subjective speculation may come into play. Happily these instances are rare. These remarks are inserted because although the facts are well-known to Indo-Europeanists, they are largely unknown to Amer:canists.

The bearing the above has on the problems of American linguistics is this: since American Indian languages have not been transmitted to us in the manner that Indo-European languages have, we do not know what has disturbed phonetic laws in many given cases, and for the methodical reasons outlined above, we are not justified in assuming that the same influences have been at work in American Indian languages as in Indo-European languages. Herein lies our difficulty in formulating phonetic laws that are entirely satisfactory to the Indo-Europeanist. For example, *n* becomes *c* in Fox before *i* which is a new morphological element; it remains if the *i* is not such an element. There are some specific grammatical categories in which the law does not work. A study of several related dialects shows that this change also takes place in them, and hence must be very old. At the same time the apparent exceptions have not been explained. Whether they ever will be, is questionable. Yet an Americanist does not object to the formulation of the law as it works in practice. The Indo-Europeanist will object vigorously to such a formulation as it is contrary to his accepted canons. If the canons of Indo-European philologists be accepted, it is quite evident Americanists can not reconstruct the parent languages of American Indian stocks in an entirely satisfactory manner. However, most Americanists are far more interested in observing actual phonetic correspondences and the like between the different dialects of linguistic stocks as they actually occur, than in speculations which from the nature of the case must rest upon rather slim foundations. It may also be noted in this connection that Indo-Europeanists have begun to interest

Digitized by Google

Original from
HARVARD UNIVERSITY

themselves more with the linguistic problems of historical languages, and less with the remote Indo-European parent language.

Let us return again to the question of the multiplicity of American stocks. As stated above, this is today almost without parallel. However it does not follow that this has always been the case. In Europe we know definitely that Etruscan has been wiped out; but we do not know how many distinct stocks were obliterated by the spread of Indo-European languages. It is entirely possible that many have been so obliterated. If they have, we have then a case quite analogous to the situation in America. But this is merely speculation. The problem may be approached from a different point of view. There is no reason to suppose that the migration from Asia was all from a single stock, in other words, that the differentiation has all been on American soil. Were that the case, in spite of the enormous lapse of time, surely we would be able to find at least one striking morphological trait common to all American Indian languages, for the morphology of a language is its most permanent feature.

Though, as intimated above, we have an apparent multiplicity of stocks which can not be reduced, nevertheless a number have resemblances to each other. An example is Siouan and Muskogean. The question resolves itself to this: Are these resemblances indicative of a common origin so remote that it is no longer possible absolutely to prove it, or are such similarities due to borrowings? To settle the question we must know what may be borrowed. That sounds may be borrowed across extremely divergent linguistic stocks is abundantly proved by the languages of the Northwest coast where we have the condition that languages whose morphology and vocabulary are distinct have practically the same phonetic elements. That vocabulary may be borrowed across linguistic stocks is too well-known to require illustration. That syntax may be borrowed across linguistic stocks is shown by the languages of Mexico where Spanish syntax has patently influenced that of American Indian languages. At this point we may ask a question, namely, can morphological features be borrowed? This is one of the most pressing problems of linguistic science awaiting solution. Unfortunately we have

Digitized by Google Original from HARVARD UNIVERSITY

little material at hand definitely to prove or disprove it. Such as we have tends strongly to establish it. For example it is patent that the post-positions of Wishram (Chinookan stock) are due to the influence of Sahaptian, a distinct though contiguous stock. Similarly, classifiers are common to the Salishan, Wakashan, Chimmesyan, Koluschan, and Skittagetan stocks which are at the same time contiguous. One may suspect, indeed, that the first pair, and similarly the last pair, have differentiated from a common ancestor. Yet at the very best we would have a single striking morphological trait spread throughout three stocks which otherwise have nothing in common in either morphology or vocabulary, but only have resemblances in sounds. It is too great a strain on the imagination to believe that this is wholly the result of chance. If the accepted definition of stock is to remain, namely, a stock consist of one or more languages all of whose sounds, morphology, syntax, and vocabulary genetically have descended from a single ancestor, we must admit at once that this trait which is held in common, is due to borrowing. For the differences in vocabulary and morphology are so enormous that it is inconceivable that the present differences are solely due to later differentiation. The vocabulary and morphology which cannot be explained at present are just as important as the extremely small percentage that can. There are a few other cases in which morphological borrowings between stocks is plausible, but they are entirely too few in number to warrant us at present in applying the principle broadcast. So we have to content ourselves in the meanwhile in pointing out structural resemblances between stocks, such as between Esquimoan and Algonquian, which resemble each other strikingly in their pronominal systems, and to a much less extent in the building up of verbal stems, in the hope that a careful and minute study of all the dialects of such stocks may enable us definitely to affirm whether such traits are due to early differentiation from a common remote ancestor or to comparatively recent borrowings.

It must be admitted that recently there has been a decided tendency among Americanists to consolidate such stocks as

Digitized by Google Original from HARVARD UNIVERSITY

show only a moderate amount of common lexical and morphological resemblances. In some cases, such as Uto-Aztecan, it must be conceded that the burden of proof is now definitely on those who maintain that the two "stocks" are true distinct stocks, and not differentiations from a common ancestor. It is on the other hand equally certain that the genetic connection has not been established with absolute nicety. In the same manner Athapascan, Koluschan, and Skittagetan are almost certainly genetically related. Their morphological resemblances are so numerous and so special that it is incredible that they are due solely to borrowings, and not to genetic relationship. However, the amount of lexical material the three have in common is an exceedingly small percentage of their total vocabulary. The extremely large percentage of the unexplained lexical material forces us to admit that this has been derived from outside sources, and with our present definition of "stock," a purely genetic relationship between the three breaks down. After all, our difficulties all hinge on our definition of "stock," and the proofs necessary to show that one or more languages constitute such a "stock." Though the definition of "stock" given above, may be rigorously correct, the actual application of it would practically obliterate the total number of "stocks" in the world, and we should be worse off than ever. For in that sense, there are few, if any, languages which constitute a stock. In the writer's opinion philologists have taken over biologists' concepts without inquiring whether they are suitable to their own science. "Stock" must be redefined in a way that has some real meaning, and some term or terms invented to cover those larger groups which apparently are only remotely related, which may be related in sounds, morphology, syntax, and vocabulary, but not all combined as a unit. It goes without saying that the nature of the proofs then demanded will be in accordance with our definitions.

To revert to a point brought out above. If the morphology of languages can not be borrowed, with scrupulous nicety we must assume an enormous number of distinct stocks at the very dawn of man, which certainly is not plausible. If on the other

Digitized by Google Original from HARVARD UNIVERSITY

hand, sounds, morphology, syntax, and vocabulary have no innate connection (vide supra) then we would have a series of various borrowings instead of "stock" in its present sense. It may be well however, to state that no matter how "stock" is defined at present, it certainly is not used in that sense alone, but in a more loose way, almost according to the whim of the author.

The most decisive proof that two or more languages belong to the same stock, used in a somewhat free sense, is numerous and detailed resemblances in their structures. A large percentage of vocabulary held in common is a welcome additional proof. The most decisive proof that a single language constitutes a special stock is numerous unique morphological features. No amount of purely lexical resemblances between languages, no matter how far apart geographically, would prove that they belonged to a single stock. For, experience has shown us that vocabulary is very often borrowed in large amounts, and hence is not a good criterion. If the tribes were far apart geographically, that would not preclude the possibility that in prehistoric times they had been in contact, and at that time extensive borrowing had taken place. Another reason why vocabulary is not a good criterion is that the number of words in even distinct stocks that superficially resemble each other is really considerable. An example is Sanskrit (Indo-European stock) *áśan-*, Fox (Algonquian stock) *asenⁱ*, both meaning "stone." Comparisons of vocabulary are only valuable when we know that the morphology of the languages compared are the same, or at least very similar. Otherwise we should not know whether we were dealing with comparable elements, even if the words in their totality resembled each other. For example, the comparison of the pronoun Avestan *čiš*, Greek τίς, Latin *quis*, Oscan *pis*, all meaning "who," is entirely justifiable, because the structure of all four languages is fundamentally the same; and, which is also important, it has been shown that though these words apparently resemble each other only slightly, yet as a matter of fact the correspondence of the various sounds forming these words is precisely what we should expect from our knowledge

Digitized by Google

Original from HARVARD UNIVERSITY

of comparative Indo-European phonology. Another example of a case where words of two different stocks superficially resemble each other is Sanskrit *naṣṭa-* "dead," Fox *ne'tōw^{a}* "he kills." It will be recalled that the combination of a sibilant followed by *t* appears as *'t* in Fox. As soon as we note that Sanskrit *naṣṭa-* is composed of the elements *naṣ+ṭa-* and Fox *ne'tōw^{a}* of the elements *ne+'tō+w^{a}*, the comparison ceases to interest us. [The Fox word can, as I think, be reduced still further in analysis, but this only still further emphasizes the point at issue.] We should exercise the same prudence in comparing morphological elements. For example the verbal termination of Latin in the third person singular is *t* which superficially resembles Tsimshian *t*, to say nothing of similar terminations in various Algonquian dialects. Again Greek μεν, the verbal termination of the first person plural, has an entirely fortuitous resemblance to Ojibwa *min* in *ni—min, ki—min* of the independent mode.

Turning now to the classification of the languages belonging to single stocks,—it must be said that very little work has been done on this important topic in American linguistics. The three stocks of which we have the best knowledge in this respect are Salishan, Siouan, and Algonquian. To a certain extent the classification is arbitrary. We select a number of salient features and base our classification on it. In most cases we have overlappings which are indicative of more than one association. For example, Peoria fundamentally belongs with the Ojibwa division of Central Algonquian languages; at the same time there are certain traits which clearly prove that it has also had an association with the Sauk, Fox, Kickapoo group, also one with Cree; and there are some indications of contact with Delaware-Munsee. Nevertheless in spite of such short comings, we can make classifications which are entirely satisfactory even to the Indo-European philologist. The object of our classifications is to determine the prehistory of the tribes of any given stock. For example, the Abnaki dialects exhibit so many special traits in common with Shawnee, as well as Sauk, Fox, Kickapoo, that it is absolutely certain that in prehistoric times the tribes

Digitized by Google
Original from
HARVARD UNIVERSITY

speaking these dialects have been in long and intimate contact. In the same way the Central Algonquian dialects are all so closely related, that it is evident that the place of diffusion must have been of limited area. The present geographical distribution of the tribes is insignificant in comparison with the evidence obtained by linguistic procedure. Nevertheless it has its value. It can not be accident that the most divergent Algonquian languages are spoken at the extreme western boundary of the stock.

This last brings us to the question of whether the differentiation of a stock into various dialects is due to evolution without external influence or whether it is due to linguistic shock. To this we reply that every case must be judged on its own merits. Peoria, though spoken today by only a handful of people, has been and is, exposed to far greater linguistic shock than Ojibwa which is spoken by several thousand persons; and, notwithstanding, is in many essential points a far more archaic language than Ojibwa. At the same time its diverse affinities indicate a series of shocks. Similarly, it can hardly be doubted that the divergent character of Aleutian (Esquimauan stock) is due to such shock. It should be candidly admitted that our studies in American linguistics have not yet reached a point where these problems can be answered in a thoroughly satisfactory manner.

It will be remembered that we are not in the position of the Indo-European philologist who can observe what has happened in the differentiation of dialects in a space of several centuries, and thereby draw legitimate inferences as to what happened in the prehistoric period. We also lack good time-measures; so we can not tell how long it has taken such and such a dialect to differentiate itself from its kindred. In this connection it should be stated that the Indian words cited by early travellers and missionaries are so badly recorded, that if the language from which the word is cited, is still extant, ordinarily we can do far better with the words spoken today. The methodical error of using the analogy of Indo-European languages in solving the points at issue, has been shown above. Our guesses from such inferences might be very happy, but they would remain guesses, not proved

Digitized by Google Original from HARVARD UNIVERSITY

facts. Our whole endeavor should be to place American linguistics on a rigid scientific basis, not upon a foundation of guesses. If I have spoken strongly on this point it is because some of the most eminent Americanists apparently desire to do the latter. They wish, without sufficient reserve, to consolidate stocks that apparently resemble each other, and are content to leave it to the next man to prove or disprove their cases. I do not deny that very likely they have made some extremely happy guesses, but I do deny that the *evidence thus far produced*, has been of such a nature as to compel acquiescence in all the results they claim to have obtained.

The opponents of the views here expressed will reply that the proofs demanded are more suitable to the so-called exact sciences than they are to philology; that if such a program be adhered to, we can not possibly hope to accomplish our task, as the languages are rapidly disappearing; that they are interested only in great facts, not minutiae; and that Indo-European philologists concern themselves largely with the latter simply because the great facts of Indo-European philology are known, and hence there is nothing else left for them to busy themselves with. To all of which the following rejoinder may be made: The proofs demanded may possibly be more rigid than those the Indo-Europeanists ordinarily demand, but it should be noted that every year the proofs demanded by the latter are becoming more and more rigorous, so that the disparity is after all being rapidly reduced, and in time doubtless the proofs demanded by philology will be fully comparable to those demanded by the exact sciences; that there is no advantage in erecting a magnificent edifice on such a weak foundation that it may topple over any minute; it is better to do even a little, and that portion well; and lastly, though it may be granted that Indo-Europeanists today are primarily concerned with minutiae, the discoveries of Grimm, Grassmann, Verner, Brugmann, Collitz, Schmidt, Ascoli, de Saussure—all of which were due to more rigorous methods—are of capital importance; and lastly it should be observed that centuries of quasi-scientific study of languages preceded the discovery of the genetic relationship of Indo-European languages,

Digitized by Google
Original from HARVARD UNIVERSITY

which of course will be counted as the great fact of Indo-European philology.

To change to a different topic. The study of American Indian languages will show that there is no such thing as superiority in language. They all possess the necessary machinery to express the most complicated ideas. The point is simply that what is grammar in one language may be vocabulary in another, and vice versa. For example there are no prepositions in Algonquian languages, but what we call prepositions are expressed by grammatical processes or special features in vocabulary. Thus "on" will be expressed by the locative case. "To come in" in Fox is *pīti*, "to go out" is *nōwi*. Nor is the language of primitive peoples indicative of low mentality. Thus Fox has but two fractions, one-half and one-quarter. It does not follow at all that the Fox Indians can not conceive of other fractions. As a matter of fact they can. The point is that ordinarily their life is such that there is no necessity for expressing them. I have tested this again and again by asking interpreters how to say, "Give me a third of that pie," and the like. In every case they were able without the slightest hesitation to render the idea, though not the precise words. I mention this simply because Gobineau apparently still has a goodly number of followers and admirers.

In conclusion, the study of American Indian languages is an extremely attractive field for students of general linguistics; and one that as yet is almost virgin soil. By their study the Indo-European specialist will find his scope vastly broadened, especially in the so-called philosophical bearings of his science. The American ethnologist who neglects their study, places himself wholly at the mercy of interpreters; or at the best must rely on the ipse dixit of his wiser colleagues. For these reasons their scientific study should be fostered in every possible way.

Digitized by Google Original from HARVARD UNIVERSITY

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

GEOLOGY.—*Structure of the Vicksburg-Jackson area, Mississippi.* OLIVER B. HOPKINS. U. S. Geological Survey Bulletin 641–D. Pp. 93–120, with 1 plate. 1916.

The object of this report is to show which of the areas in west-central Mississippi that were examined by the Survey are considered favorable and which unfavorable for the occurrence of oil, to discourage drilling in the unfavorable localities, and thus to aid those interested in making conclusive tests to determine the presence or absence of oil and gas.

All the rocks of the area are sedimentary in origin and are relatively young, the exposed rocks ranging in age from Claiborne (Eocene) to Recent. Of these formations the loess and the Jackson underlie by far the greater part of the area, and the Vicksburg and Catahoula formations and the terrace sand and gravel underlie smaller areas.

The general structure of the Gulf coastal plain is simple. A series of beds slopes gently southward and passes successively deeper and deeper beneath more recent deposits toward the coast. This general dip toward the coast is interrupted by local steepening or flattening and in a few places by a reversal in direction. These irregularities of dip, which are of greatest significance in the accumulation of oil and gas in valuable pools, are well illustrated in the Vicksburg-Jackson area. The geologic structure is represented on a map by contours on the Vicksburg limestone. The possibilities of oil and gas occurring in the area are dicussed and the most promising areas for prospecting are pointed out. R. W. S.

Digitized by Google Original from HARVARD UNIVERSITY

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 785th Meeting was held at the Cosmos Club, March 3, 1917. Vice President HUMPHREYS in the chair; 49 persons present. The minutes of the 784th meeting were read in abstract and approved.

By invitation, Mr. A. H. PFUND presented an illustrated communication on, *The colors of mother-of-pearl.* At the request of the U. S. Bureau of Fisheries the following work was undertaken to ascertain the cause of the iridescence of mother-of-pearl. While this subject has been studied before, the results have been largely of a qualitative nature. By extending the observations into the infra-red region of the spectrum where conditions are much simplified, the author has succeeded in obtaining quantitative measurements which substantiate the explanation of the colors of mother-of-pearl as given by Sir David Brewster.

Under the microscope, a thin section of the shell of a fresh-water mussel is seen to consist of three layers—the inner one being the true mother-of-pearl (nacreous matter). This, in turn, consists of innumerable thin layers of $CaCO_3$ separated by extremely thin layers of organic matter. As the shell grows, successive layers of nacreous matter are deposited on the inside of the shell—each layer projecting slightly beyond the terminal edge of its predecessor. Hence the outside of the nacreous layer will present closely spaced steps or ridges running parallel to the growing edge of the shell. Such a surface structure is identical with that of a diffraction grating, and hence diffraction colors ought to exist. By laying bare the outer surface of the nacreous matter and depositing an opaque layer of silver on it, striking diffraction colors are seen. This surface structure may be studied most readily by means of celluloid casts or replicas of the surface. These replicas show brilliant diffraction colors. Under the microscope the individual lines may be seen and the spacing may be determined. While this is subject to wide variations, the range of spacing observed on the outside of the shell of a fresh-water mussel ranges from 6000 to 25,000 lines per inch. As might be expected, no trace of such a grating-like structure is obtained from the inside of the shell.

As a rule, the diffraction colors are rather inconspicuous, being masked by the blaze of colored light from underlying regions. Since this light is due to reflections from the numerous laminae and since these are parallel and sensibly equi-distant, coloration due to interference might be expected. According to the usual theory, the optical

Digitized by Google

Original from
HARVARD UNIVERSITY

retardation of two beams reflected from two successive layers is $2\mu e \cos r$ where e is the thickness of the layer, μ the refractive index and r the angle of incidence. If this retardation is a whole number of wave-lengths, constructive interference will take place. Hence maxima of intensity will exist when

$$2\mu e \cos r = \lambda_1, 2\lambda_2, 3\lambda_3$$

etc., where

$$\lambda_2 = \frac{\lambda_1}{2} \text{ and } \lambda_3 = \frac{\lambda_1}{3}$$

Such maxima were looked for by reflecting white light from the polished surface of nacreous matter and by measuring the intensities in the various spectral regions by means of a spectrometer and vacuum thermo-couple. Since the interference maxima are most widely separated and are sharpest in the infra-red, the observations were carried out in this spectral region. Results obtained from brilliantly colored specimens were entirely in agreement with the above theory, i.e., the wave-lengths of the interference maxima were in the ratio $1:\frac{1}{2}:\frac{1}{3}$. This quantitative determination proves definitely that the brilliant iridescence of mother-of-pearl is due to interference.

By determining the refractive index of the nacreous matter, it was found possible to determine the actual thickness of the laminae. The results, which differed somewhat for different specimens, showed that the thickness is of the order 0.4–0.6μ.

Discussion. The paper was discussed by Messrs. SOSMAN and WRIGHT. Mr. Pfund was of the opinion that the number of layers of material in the shells examined was too great to correspond with the number of days or with the number of tides occurring during the life of the shell.

Mr. W. F. MEGGERS then presented an illustrated paper on *Interference measurements of wave-lengths, and infra-red spectrum photography.* Interference measurements of wave-lengths in the portion of the iron arc spectrum in which the International Secondary standards exist (3233 A to 6750 A) have been made at the Bureau of Standards. The wave-lengths of about 320 lines were compared with those of the 85 secondary standards by the interferometer method of Fabry and Pérot. The average interval between standards was thus reduced from 40 A to 8 A, making accurate interpolation easier. Whereas 86 per cent of the secondary standards have intensities 4 to 6 inclusive, only 47 per cent of the new lines have these intensities, the remainder being distributed among fainter and stronger lines. This makes it possible to photograph sufficient standards with a wider latitude of exposure.

Similar measurements were made in the spectra of the rare gases, helium, neon, argon, krypton, and xenon. The wave-lengths were compared with the fundamental spectroscopic standard (wave-length of red radiation from cadmium = 6438.4696 A). The measurements in the neon spectrum show differences in the numbers of waves per

Digitized by Google Original from HARVARD UNIVERSITY

centimeter (frequency differences) to be constant to 1 part in several millions.

An extensive application of these standardized wave-lengths has been made to an investigation of spectra in the red and adjacent infrared regions. The arc spectra of 20 of the chemical elements have been photographed from 6000 A to 9000 A and beyond. The photographs were made in the first order spectrum of a concave grating of 640 cm. radius. Ordinary photographic plates stained in dicyanin solution were used and found to be quite sensitive to the long waves. Wave-length measurements on the international scale have been made in these spectra and most of the frequency differences in the spectra of the alkali metals are shown to be constant to 1 part in several hundred thousand of the wave number.

Mr. F. E. Fowle presented an illustrated paper on *Spectroscopic field light.* When a spectrum is formed the energy observed at any wave-length is not simply what is proper to that wave-length but it is diminished by a portion scattered into other parts of the spectrum

TABLE 1

Spectroscopic Field Light

1. Wave-length in μ	1.8	5.7	7.0	8.0	10.0	12.0	14.0	17.5
2. Deviation in minutes	0	10	15	20	30	45	60	100
3. Quartz transmits	85,000	206	117	85	50	27	17	8
4. Ditto corrected	100,000	242	141	100	59	30	20	10
5. Total field light		244	146	107	66	33	22	11
6. Black-body radiation	100,000	5000	1800	1000	400	140	65	20
7. Nernst-lamp radiation	100,000	5000	1800	1000	400	140	50	2

and increased by portions scattered in from other regions. In measurements in long-wave spectra this scattered radiation or field light may become very important and troublesome. Rock-salt prismatic energy curves were made of the radiation from a Nernst lamp with a half-centimeter thick quartz plate inserted between the energy source and the silt of the spectroscope. The quartz is nearly transparent for light waves less than 4μ in length, and opaque for those longer. The resulting energy curves consisted of two parts of quite different significance: 1st, a nearly symmetrical sharp maximum, the energy curve of the source to 4μ; 2nd, beyond this the energy curve of the light scattered from this region into that for which quartz is opaque. This central maximum with a wing-like appendage on each side was assumed to represent closely the energy curve of a monochromatic line with the radiation scattered to each side in the spectrum. This curve was used to compute the energy scattered into and away from each region of the spectrum. A summary of the results is given in Table 1 in which the captions in the first column have the following significance:

(1) Wave-lengths in millionths of a meter μ; (2) Deviation differences in minutes of arc, 15° rock-salt spectrum, zero deviation at 1.8μ;

Digitized by Google Original from HARVARD UNIVERSITY

(3) Nernst-lamp spectrum observed through a ½ cm. quartz plate; (4) Ditto corrected to allow for the reflections from the surfaces of the quartz plate; nearly equivalent to ordinates of the energy curve of a monochromatic line with the energy scattered to the long-wave side; (5) Total field light which would be expected in the spectrum of a Nernst lamp when the intensity of the latter is 100,000 at 1.8μ (see line 7); (6) Computed relative intensities in black-body spectrum of a body at 2200°K radiating to one at 300°K; (7) Corrected observed intensities of Nernst-lamp spectrum approximating the conditions of line 6 but differing for wave-lengths greater than 12μ because of the increasing absorption of energy in the rock-salt plate closing the vacuum bolometer case and in the prism, and the decreasing absorption by the lamp-blacked surface of the bolometer strip. The intensity of the scattered energy is really very small in any given region although the total amount lost from any region amounts to about 3 per cent of the true intensity of the region. At an angle of 10 minutes from the direction in which the beam is normally reflected the intensity of the scattered energy is only about 0.2 of 1 per cent of that of the main image. It will be noted in the table that at 17.5μ the field light is over five times the true-energy in the lamp spectrum. From a badly tarnished mirror the increase in scattered light is relatively greater for greater deviations from the main image. (This paper will probably appear in the Astrophysical Journal.)

Discussion. Mr. C. G. Abbot commented on the large amount of work necessary to obtain the results presented.

Informal communications. Mr. C. G. Abbot spoke of difficulties in producing satisfactory damping in galvanometers, and Mr. W. P. White mentioned a variation in damping with the magnitude of the deflection, that would seem to be due to the damping effect of the air in the clearance space between the armature and the pole pieces.

Donald H. Sweet, *Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 567th regular meeting of the Society was held in the Assembly Hall of the Cosmos Club, Saturday March 10, 1917; called to order by President Hay at 8 p.m.; 45 persons in attendance.

On recommendation of the Council, Mrs. L. O. Howard and Dr. Martha Brewer Lyon were elected to active membership.

Under the heading book notices, brief notes, etc., Dr. H. M. Smith exhibited a manuscript and hand-illustrated book dealing with beetles. It was about 60 years old. Dr. Smith presented it to Dr. L. O. Howard. Prof. W. P. Hay presented some notes on the flying squirrels of this vicinity with observations on their habits and behavior as pets. Dr. H. E. Ames called attention to a newspaper clipping recording the flight of two tagged ducks a distance of 2000 miles in about 60 hours. He sought verification of the statement.

Digitized by Google Original from HARVARD UNIVERSITY

The regular program consisted of two communications:

M. W. LYON, JR.: *Precipitins.* Dr. Lyon described an antibeef-serum he had lately prepared, and set up a series of test tubes containing dilutions of beef, sheep, hog, and human serums. He demonstrated the action of the antibeef-serum on these, the specific precipitation when added to the diluted beef serum, the group precipitation with diluted sheep serum, and the non-precipitation with diluted hog and human serums. He mentioned briefly the history and theory of precipitating serums and explained their use in identifying suspected animal proteins and in showing the blood relations of various animals. In discussing this communication A. H. JENNINGS explained how he had made use of the precipitin reaction in determining the kinds of animals bitten by biting flies. Dr. GEORGE W. FIELD and H. F. TAYLOR also took part in the discussion.

WILLIAM PALMER: *Porpoises and steamers.* Mr. Palmer commented on the frequency with which porpoises are found about the bows of steamers and advanced explanations as to their presence there and as to their methods of progression. His communication was illustrated by diagrams and lantern views of porpoises and other cetaceans. It was discussed by Dr. H. E. AMES.

M. W. LYON, JR., *Recording Secretary.*

Digitized by Google Original from HARVARD UNIVERSITY

ANNOUNCEMENT OF MEETINGS OF THE ACADEMY AND AFFILIATED SOCIETIES[1]

Thursday, April 19: The Philosophical Society, at the Cosmos Club, at 8.15 p.m. Program:

1. LANGMUIR: *The constitution of liquids* (illustrated).

Saturday, April 21: The Biological Society, at the Cosmos Club, at 8 p.m.

Wednesday, April 25: The Geological Society, at the Cosmos Club, at 8 p.m.

Tuesday, May 1: The Botanical Society, at the Cosmos Club, at 8 p.m.

[1] The programs of the meetings of the affiliated societies will appear on this page if sent to the editors by the thirteenth and twenty-seventh day of each month.

Digitized by Google

Original from HARVARD UNIVERSITY

CONTENTS

Original Papers

Page

Physical Chemistry.—A convenient form of autoclave. George W. Morey. 205

Mineralogy.—Leverrierite from Colorado. Esper S. Larsen and Edgar T. Wherry 208

Medical Zoology.—The carriage of disease by insects. L. O. Howard 217

Ethnology.—Remarks on American Indian languages, a study in method. Truman Michelson 222

Abstracts

Geology 235

Proceedings

The Philosophical Society of Washington 236

The Biological Society of Washington 239

Digitized by Google

Original from HARVARD UNIVERSITY

LIBRARY
PEABODY MUSEUM
RECEIVED
NOV 3 1955

Vol. VII No. 10
May 19, 1917

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

BOARD OF EDITORS

N. Ernest Dorsey — Bureau of Standards
Adolph Knopf — Geological Survey
A. S. Hitchcock — Bureau of Plant Industry

PUBLISHED SEMI-MONTHLY
EXCEPT IN JULY, AUGUST, AND SEPTEMBER, WHEN MONTHLY
BY THE
WASHINGTON ACADEMY OF SCIENCES

OFFICE OF PUBLICATION
WILLIAMS & WILKINS COMPANY
BALTIMORE, MD.

Entered as second-class matter July 14, 1911, at the post office at Baltimore, Maryland, under the Act of July 16, 1894

Digitized by Google
Original from
HARVARD UNIVERSITY

Journal of the Washington Academy of Sciences

This JOURNAL, the official organ of the Washington Academy of Sciences, aims to present a brief record of current scientific work in Washington. To this end it publishes: (1) short original papers, written or communicated by members of the Academy; (2) a complete list of references to current scientific articles published in or emanating from Washington; (3) short abstracts of certain of these articles; (4) proceedings and programs of meetings of the Academy and affiliated Societies; (5) notes of events connected with the scientific life of Washington. The JOURNAL is issued semi-monthly, on the fourth and nineteenth of each month, except during the summer when it appears on the nineteenth only. Volumes correspond to calendar years. Prompt publication is an essential feature; a manuscript reaching the editors on the second or the seventeenth of the month will ordinarily appear, on request from the author, in the next issue of the JOURNAL.

Manuscripts may be sent to any member of the Board of Editors; they should be clearly typewritten and in suitable form for printing without essential changes. The editors cannot undertake to do more than correct obvious minor errors. References should appear only as footnotes and should include year of publication.

Illustrations will be used only when necessary and will be confined to text figures or diagrams of simple character. The editors, at their discretion, may call upon an author to defray the cost of his illustrations, although no charge will be made for printing from a suitable cut supplied with the manuscript.

Proof.—In order to facilitate prompt publication no proof will be sent to authors unless requested. It is urged that manuscript be submitted in final form; the editors will exercise due care in seeing that copy is followed.

Authors' Copies and Reprints.—On request the author of an original article will receive gratis ten copies of the number containing his contribution and as many additional copies as he may desire at five cents each. Reprints will be furnished at the following schedule of prices:

	4 pp.	8 pp.	12 pp.	16 pp.
50 copies	$1.08	$1.95	$2.93	$3.80
100 copies	1.30	2.40	3.60	4.70
Additional copies, per 100	.45	.90	1.35	1.70

Covers bearing the name of the author and title of the article, with inclusive pagination and date of issue, will be $2.00 for the first 100. Additional covers $1.00 per 100.

As an author may not see proof, his request for extra copies or reprints should invariably be attached to the first page of his manuscript.

The rate of Subscription per volume is	$6.00*
Semi-monthly numbers	.25
Monthly numbers	.50

Remittances should be made payable to "Washington Academy of Sciences," and addressed to the Treasurer, William Bowie, Coast and Geodetic Survey, Washington, D. C., to Williams & Wilkins Company, 2419-2421 Greenmount Ave., Baltimore, Md., or to the European Agents.

European Agents: William Wesley & Son, 28 Essex St., Strand, London, and Mayer and Müller, Prinz Louis-Ferdinand Str., Berlin.

Exchanges.—The JOURNAL does not exchange with other publications.

Missing Numbers will be replaced without charge, provided that claim is made within thirty days after date of the following issue.

* Volume I, however, from July 19, 1911 to December 19, 1911, will be sent for $3.00. Special rates are given to members of scientific societies affiliated with the Academy.

THE WAVERLY PRESS
BALTIMORE, U. S. A.

Digitized by Google
Original from HARVARD UNIVERSITY

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. VII | MAY 19, 1917 | No. 10

GEOLOGY.—*On the terms aphrolith and dermolith.* T. A. JAGGAR, JR., Hawaiian Volcano Observatory. (Communicated by Arthur L. Day.)

Dutton[1] in describing Hawaiian volcanoes made use of the terms aa and pahoehoe, and these words of Hawaiian origin have been somewhat adopted by American geologists. Some English geologists object to them strongly and continental usage is various in the matter. Aa lava of the Hawaiians is characterized by a peculiar mechanism of solidification of olivine basalt, whereby a magma surcharged with gas so froths or foams in its surface layer that on solidification this layer shrivels and separates into discrete scoriaceous units, in some places light and pumiceous, but elsewhere heavy and slaggy. The extreme pumiceous type is the limu, or "thread-lace scoria" of Dana. The lava flow beneath solidifies as a coarsely vesicular body grading downward into crystalline rock which has no known petrographical peculiarity different from any other type of flow. The boundary surface at the top of the continuous sheet and below the discontinuous layer of scoriae is revealed at many places on the shoreline of Hawaii, where the ocean has swept the loose material away. In these places the surface revealed is rugose and in detail much like the scoriaceous fragments, but it sometimes exhibits coarse ropy forms and rough festoons

[1] DUTTON, C. E. *Hawaiian Volcanoes.* 4th Ann. Rep. U. S. Geol. Surv., 1882-83.

Digitized by Google

Original from HARVARD UNIVERSITY

in plan. The distinctive feature of typical aa, however, is the shrinkage of the surface into units from a few centimetres to several metres in diameter, each unit being complete in itself and commonly free from broken surfaces. Such lava is spoken of in text books which have not adopted the Hawaiian word, as fragmentary lava, block lava, or scoriaceous lava, and in the southwestern states the Mexican word "malapai" or "malapis" is used for the vast fields of aa which there occur. In the Cordilleran belt and elsewhere great bodies of ancient aa are called pyroclastics, breccias, and agglomerates indiscriminately, along with explosion products that are of totally different origin. Aa makes a pyroclastic where igneous matrix is apt to be identical with the contained fragments, and the fragments are of irregular lumpy outline.

The pahoehoe lava of the Hawaiians, on the other hand, is distinguished by smooth surfaces which result from the formation of a glassy membrane or skin. The mode of congelation of olivine basalt magma advancing as a pahoehoe flow is very strikingly different from that of an aa flow. The surface of the lava lake of Kilauea in all stages of its crusting is typically pahoehoe. As the heat is radiated from the surface, solidification forms a dermal layer made of filaments of glass remnant from expanding bubbles filled with gas, and these show no tendency to burst explosively, but incessantly crowd into the interstices of the stretching and rending layer of filaments of previous formation. The result is a skin not usually gas tight and exhibiting extraordinary diversity of texture. Solidification proceeds from without inwards, the skin reaches various thicknesses and then folds, and the folding distributes itself somewhat like the moraines of a glacier with festoons drawn downstream farthest along the middle line and retarded at the two sides. At the sides there are lengthwise curtains produced by the longitudinal drag between resistant cooling margins and the festooned stream in the middle. At the front, toes of the molten fluid push out from under the skirts of the flow in peculiar tuberous bodies, which tend to congeal on all sides and may even lift their tips vertically and solidify. They ap-

Digitized by Google Original from HARVARD UNIVERSITY

pear to be blown by expanding gas, for the axis is almost tubular in its coarser vesicularity. The spasmodic renewed advance of a pahoehoe flow is frequently characterized by pushing out from under a skirt of crust, in contrast to the aa flow which appears to solidify from below upward and to advance by overriding its already solidified lobes. Pahoehoe lava is variously mentioned in the text books as fluent, smooth, ropy, or corded lava.

Visually the two types of lava, in mobility and temperature, appear much alike while incandescent and flowing rapidly as golden streams. With the beginnings of solidification, however, the difference is pronounced, pahoehoe forming skins and aa forming knobs and cinders like a bed of hot coals. The cooling front of an aa flow is full of flames through the apertures of the blocks. The front of a pahoehoe flow shows no flames detectable by eye. The aa flow at its front is in a brittle semi-solid condition, slabs rifting away and falling forward from a mass beneath that resembles hot iron. Pahoehoe, on the other hand, bellies its crust forward, escapes as a viscous pudding and this in turn skins over, the whole movement resembling the advance of candy or tar.

The explanation of the physico-chemical difference between the two types remains to be discovered, as chemical analysis in the same region has as yet revealed no distinction. It seems probable that the quantity of confined gas, in solution or in bubble form, for each unit of volume of melt, controls the mode of freezing. Possibly the gases are nearer equilibrium in pahoehoe than in aa. The heat equation plays an important role, and this involves reaction between the gases as well as their oxidation in air. Gas expansion may be more rapid in aa and so induce internal solidification. Furthermore, there are enormous differences in the state of oxidation of the iron at the moment of cooling, and as yet we know nothing of the progress of crystallization in the field. With so many variables there is no cause for wonder that the distinction is as yet unexplained.

Between pahoehoe and aa flows in Hawaii there are unquestionably gradations of many appearances and perhaps of many

Digitized by Google Original from HARVARD UNIVERSITY

kinds, but this the writer doubts. By this is meant that the gradations may be mixtures of two substances rather than stages of one substance. This is only a suggestion in the present condition of our knowledge, based on the discovery, reported in a previous note, that the lake bottom or bench magma of Kilauea was found solidified as aa, whereas the lake magma solidifies as pahoehoe.

In view of the diversity of usage cited above, and of the confusion which results when pahoehoe crusts break up and make a "fragmentary" or "block" lava not at all of aa character, or when aa flows are revealed scoured bare and show "ropy" or "corded" aspect without being in the least of pahoehoe origin, I believe that volcanology needs a terminology scientifically descriptive of the two groups of effusive magmatic bodies, and capable of adaptation as adjectives, adverbs, or nouns in any modern language.

Accordingly I propose for pahoehoe the term DERMOLITH (Greek, skin + stone), to cover all those forms of effusive lava which manifest subaerially a surface skin or crust, capable of wrinkling or folding, as the chief distinguishing character.

For example, dermolithic basalts are common in Hawaii, Samoa, Iceland, Reunion, and on the Snake River plains, but dermolithic flow has not been identified at Lassen's Peak. At Mauna Loa near the vents of 1916, the lava flowed dermolithically in a coarse way, but exhibited a much rougher texture than the characteristic dermolith of Halemaumau. On the floor of Kilauea crater great fields of dermolith extend far and wide.

I propose for aa the term APHROLITH (Greek, foam + stone), to distinguish those effusive lavas or crater bodies which tend on solidification to subdivide surficially into complete irregular lumpy vesicular units, the crust surfaces of the continuous mass having protuberances of similar rugged character.

For example, aphrolithic lava flow has been dominant on the southern flank of Mauna Loa since 1868, the flow of that year being partly dermolithic. It would appear also, from the observations of 1917, that aphrolith occupies the bottom of the Kilauea lava lake and that hence the solidification of the interior

Digitized by Google Original from HARVARD UNIVERSITY

of the bench magma must proceed aphrolithically. Supposing the cumulo-domes of Bogoslof and Pelée to be essentially aphrolith, it is a matter of great interest to determine whether any dermolithic flow, however small, took place in those magmas. At Soufriere in St. Vincent, and also on Bandaisan, there are aphrolithic blocks of fresh rock quite distinct from the angular fragments, and apparently representative of the subterranean magmas which produced the explosions.

If these terms are adopted, it is hoped that they will not be changed in English to the *-lite* termination, as Harker[2] insisted on doing for "batholite," etc. The *-lite* syllable is needlessly confusing, on account of the innumerable rock and mineral names so ending. Harker's contention is that "-lith" is continental and not English, but this is disproved by such a word as *monolith*, which is accepted English of Greek derivation.

GENETICS.—*Observed changes in hereditary characters in relation to evolution.*[1] H. S. JENNINGS, Johns Hopkins University.

The problem of the method of evolution is one which the biologist finds it impossible to leave alone, although the longer he works at it, the farther its solution fades into the distance. The central point in the problem is the appearance, nature, and origin of the heritable variations that arise in organisms; the changes that occur in the hereditary constitution. I have for a long time been studying the appearance of heritable variations in certain lower organisms. Having satisfied myself as to the nature of the variations that arise in the creatures that I have studied, I have looked about to see what other workers have found; and to determine whether any unified picture of the matter can be made. Can we bring these facts which experimental work has brought out into relation with the method of evolution? Can we say that they exclude any particular theory?

[2] HARKER, A. Natural History of the Igneous Rocks.

[1] A lecture delivered before the Washington Academy of Sciences, March 15, 1917.

Digitized by Google Original from HARVARD UNIVERSITY

Can we say that they leave certain views admissible? Can we go farther and say that they make certain views probable? I shall hardly be so bold as even to ask whether they establish any particular views, though even that has been at times affirmed.

These questions have, of course, been raised thousands of times; it is only because knowledge does advance, because experimental work has been enormously multiplied of late, that there is reason to bring them up anew. I am going to try to put before you the present situation as it appears to me.

What we may call the first phase of the modern experimental study of variation is that which culminated in the establishment of the fact that most of the heritable differences observed between closely related organisms—between the members of a given species, for example—are not *variations* in the sense of alterations; are not active *changes* in constitution, but are permanent diversities; they are static, not dynamic. This discovery, like that of Mendelian heredity, was, as you know, made long ago by the Frenchman Jordan; but, as in the case of Mendelism, science ignored it and pursued cheerfully its false path till the facts were rediscovered in recent years. All thorough work has led directly to this result: that any species or kind of organism is made up of a very great number of diverse stocks, differing from each other in minute particulars, but the diversities inherited from generation to generation. This result has in recent years dominated all work on the occurrence of variations; on the effects of selection; on the method of evolution. The condition is particularly striking in organisms reproducing from a single parent, so that there is no mixing of stocks; I found it in a high degree in organisms of this sort which I studied. Thus the in usorian Paramecium I found to consist of a large number of such heritably diverse stocks, each stock showing within itself many variations that are not heritable.[2] *Difflugia corona*, which I have recently been studying, shows the same condition in a marked degree.[3] As you know, a host of workers have found similar conditions in all sorts of organisms. It led to the

[2] See JENNINGS, 1908, 1909, 1910, 1911. (See Bibliography.)

[3] JENNINGS, 1916. (See Bibliography.)

Digitized by Google Original from HARVARD UNIVERSITY

idea of the genotype (Johannsen), as the permanent germinal constitution of any given individual; it supported powerfully the conception of Mendelism as merely the working out of recombinations of mosaic-like parts of these permanent genotypes. The whole conception is in its essential nature static; alteration does not fit into the scheme.

This discovery seemed to explain fully all the observed effects of selection within a species; but gave them a significance quite the reverse of what they had been supposed to have. It seemed to account for practically all the supposed variations that had been observed; they were not variations at all, in the sense of steps in evolution; they were mere instances of the static condition of diversity that everywhere prevails. Jordan, the devout original discoverer of this condition of affairs, maintained that it showed that organisms do not really vary; that there is no such process as evolution; and indeed this seems to be the direct logical conclusion to be drawn. In these days of plots and spies, the evolutionists might almost feel that the enemy had crept into their citadel and was blowing it up from within.

Now, this multiplicity of diverse stocks really represents the actual condition of affairs, *so far as it goes*. Persons who are interested in maintaining that evolution *is* occurring, that selection *is* effective, and the like, make a very great mistake in denying the existence of the condition of diversity portrayed by the genotypists. What they must do is to accept that condition as a foundation, then show that it is not final; that it does not proceed to the end; that the diverse existing stocks, while heritably different as the genotypists maintain, may also change and differentiate, in ways not yet detected by their discoverers.

But of course most of the adherents of the "orthodox genotype theory" do not maintain, with their first representative Jordan, that no changes occur; that all is genetically static in organisms. Typically, they admit that *mutations* occur; that the genotype may at rare intervals transform, as a given chemical compound may transform into another and diverse compound. We all know the typical instances: the transforming mutations of Oenothera; the bud variations that show in a sudden change of

Digitized by Google Original from HARVARD UNIVERSITY

color or form in plants; the dropping out of definite Mendelian units in Drosophila and elsewhere; the transformation of particular Mendelian units into some other condition.

So much then may serve as an outline of a prevailing theory; organisms forming a multitude of diverse strains with diverse genotypes; the genotype a mosaic of parts that are recombined in Mendelian inheritance; selection a mere process of isolating and recombining what already exists; large changes occurring at rare intervals, through the dropping out of bits of the mosaic, or through their complete chemical transformation; evolution by saltations.

Certain serious difficulties appear in this view of the matter; I shall mention merely two of them, for their practical results. One is the very existence of the minutely differing strains, which forms one of the main foundations for the genotype theory. How have these arisen? Not by large steps, not by saltations, for the differences between the strains go down to the very limits of detectibility. On the saltation theory, Jordan's view that these things were created separate at the beginning seems the only solution.

Secondly, to many minds there appears to be an equally great difficulty in the origin by saltation of complex adaptive structures, such as the eye. I shall not analyze this difficulty, but merely point to it and to the first one mentioned, as having had the practical effect of keeping many investigators persistently at work looking for something besides saltations as a basis for evolution; looking for hereditary changes that would permit a continuity in transformation. Some have been searching in the complex phenomena of biparental inheritance; here Castle is to be first named, and in a later lecture you will hear of the views to which he has been led. Others, like Prof. H. F. Osborn, have been searching from this point of view the paleontological records. Others of us have taken up the problem in uniparental reproduction; it is here that my own work falls, and of this I will for a moment speak.

Where reproduction is from a single parent we meet the problem of inheritance and variation in its simplest form; for

Digitized by Google Original from HARVARD UNIVERSITY

there is nothing which complicates genetic problems so enormously as does the continual mixing of diverse stocks in biparental inheritance. In uniparental reproduction we have but one genotype to deal with; we can be certain that no hereditary characters are introduced from outside that genotype.

To hope for results on the problem in which we are interested, we must resolve to carry on a sort of second degree research, as it were. That is, we must accept as a foundation the facts before discovered, as to the make-up of the species out of a great number of diverse stocks; as to the usual effects of selection being nothing save the isolation of such preexisting stocks. What we must do is to take a single such stock—choosing an organism that is most favorable for such work—then proceed to a most extensive and intensive study of heredity, of variation, and of the effects of selection for long periods within such a stock.

Such an organism, most favorable from all points of view, I found in the rhizopod *Difflugia corona*. It has numerous distinctive characters, all congenital; all inherited in a high degree; yet varying from parent to offspring also; none of these characters changed by growth or environmental action during the life of the individual.

Long continued work showed that a single strain of this animal, all derived by fission from a single parent, does differentiate gradually, with the passage of generations, into many hereditarily diverse strains. The important facts about the hereditary variations and their appearance are the following:

1. Hereditary variations arose in some few cases by rather large steps or "saltations."

2. But the immense majority of the hereditary variations were minute gradations. Variation is as continuous as can be detected.

3. Hereditary variation occurred in many different ways, in many diverse characters. There was no single line of variation followed exclusively, nor in the overwhelming majority of cases.

4. It gave rise to many diverse combinations of characters: large animals with long spines; small animals with long spines; large animals with short spines; small animals with short spines;

Digitized by Google Original from HARVARD UNIVERSITY

and so on, for other sorts of combinations of other characters. Any set of characters might vary independently of the rest.

5. The hereditary variations which arose were of just such a nature as to produce from a single strain the hereditarily different strains that are found in nature.[4]

I judge that if the intermediate strains were killed, the two most diverse strains found in nature might well be classed as different species, although the question of what a species is must be left to the judgment or fancy of the individual.

Such then were the results of my own studies as to the nature of hereditary variations and how they appear. How do these results compare with those found by other men? If we take a general survey, we find the following main classes of cases:

1. First, we have the mutations of Oenothera and its relatives: large transformations occurring suddenly. Here is evidently one of the most interesting fields of genetics, but I cannot feel, in view of many extraordinary phenomena in this group, that the bearing on the main problems of genetics is yet clear.

2. Second, we have a large miscellaneous collection of mutations observed in various classes of organisms: "bud variations," dropping out of unit factors, and the like—all definite saltations, but not genetically fully analyzed.

3. In Drosophila as studied by Morgan and his associates, we have the largest and most fully analyzed body of facts which we possess with respect to changes in hereditary character in any organism. The changes here are pictured as typical saltations; but of these I shall speak farther.

4. In paleontology, as the results are presented in recent papers by Osborn,[5] the evidence is for evolution by minute, continuous variations which follow a single definite trend.

5. Finally we have the work in biparental inheritance from Castle and his associates:[6] this, as interpreted by Castle, gives evidence for continuous variation, not following a single necessary trend, but guided by external selection.

[4] The full account of this work is given in JENNINGS, 1916. (See Bibliography.)

[5] See OSBORNE, 1912, 1915, 1916. (See Bibliography.)

[6] See CASTLE, 1915 *a*, 1916, 1916 *a*, 1916 *b*, 1917; CASTLE and PHILLIPS, 1914, etc. (See Bibliography.)

Digitized by Google Original from HARVARD UNIVERSITY

Furthermore, we discover in our survey that there are at least two well-marked controversies in flame at the present time:

First, we have the general controversy between, on the one hand, those who are mutationists and adherents of the strict genotype view; on the other hand, those who, like Castle, believe that we observe continuous hereditary variations in the progress of biparental reproduction. The mutationists attempt to show that the apparent gradual modification of characters observed in breeding is in reality a mere working out of Mendelian recombinations. Here we have contributions by Morgan (1916), Pearl (1916, 1917), MacDowell (1916), Hagedoorn (1914), and others on the one hand; while the full brunt of the attack is borne on the other side by Castle.

Second, we have a somewhat less lively controversy between the genotypic mutationists and the paleontological upholders of evolution by continuous variation. Echoes of this we find in recent publications by Osborn and by Morgan.

Now let us look briefly into the points at issue in the controversy between the "genotypic mutationsts" and the upholders of gradual change during biparental inheritance.

Castle finds that in rats he can, by selection, gradually increase or decrease the amount of color in the coat, passing by continuous stages from one extreme to the other. As to this, he holds two main points:

1. The change is an actual change in the hereditary characteristics of the stock; not a mere result of the recombination of Mendelian factors. This is the general and fundamental point at issue.

2. More specifically, he holds it to be an actual change in a single unit factor; this single factor changes its grade in a continuous and quantitative manner.

On the other side, the critics of these views maintain that the changes shown are not actual alterations in the hereditary constitution at all, but are mere results of the recombinations of Mendelian factors. And specifically, they find a complete explanation of such results as those of Castle in the hypothesis of *multiple modifying factors*.

Digitized by Google Original from HARVARD UNIVERSITY

The method in which these modifying factors are conceived to operate is doubtless familiar to you: their application to Castle's work with selection in rats will serve as an example. There is conceived to be a single "main factor" which determines whether the "hooded pattern" shall or shall not be present. In addition to this there are a considerable number of "modifying factors" which, when the "hooded pattern" is present, increase or decrease the extent of pigmentation. When many of the positive factors of this sort are present, the rat's coat has much pigment; when fewer are present the extent of pigment is less, and so on. The process of changing the extent of pigmentation by selection consists, according to this view, merely in making diverse combinations of these factors, by proper crosses.

This same explanation is applied to a great variety of cases. Castle had carried the war into the enemy's country by predicting (or at least suggesting) that the so-called unit characters in Drosophila would be found to be modifiable through selection.[7] Later research by MacDowell (1915), Zeleny and Mattoon (1915), Reeves (1916), Morgan (1917), and Sturtevant (1917) actually verified this prediction; it has indeed been found that the Drosophila mutations can be modified by selection. Again the mutationists counter the blow with their explanation of multiple modifying factors, which are segregated in the process of selection; and they give some real evidence that such is actually the case.

Now, into the merits of that particular question, as to whether the apparent effects of selection are really due to modifying factors in the manner set forth, I do not propose to enter. Castle maintains that they are not, and I doubt not that he will show you reason for that point of view. At this point my own discussion will diverge from what I judge that he will be likely to give. What I am going to do is to abandon the ground that Castle would defend, proceed directly into the territory of the enemy, accept the conditions met there, then see where we come out in relation to the nature of variation, the effects of selection, and the method of evolution.

[7] See CASTLE, 1915, p. 39. (See Bibliography.)

Digitized by Google Original from HARVARD UNIVERSITY

In no other organism have heritable variations been studied so thoroughly as in Drosophila, and no other body of men have been more thoroughgoing upholders of mutationism and of the multiple factor explanation of the effects of selection, than the students of Drosophila—Morgan, Sturtevant, Bridges, Dexter, Muller, MacDowell, and the others. We may therefore turn to the evidence from Drosophila with confidence that it will be presented with fairness to the mutationist point of view. We shall first ask (1) what we learn from the work on Drosophila as to the possibility of finding finely graded variations in a single unit character. Next we shall inquire (2) as to the relation of the assumed modifying factors to changes in hereditary constitution; to the nature of the effects of selection.

1. First, then, what are the facts as to numerous finely graded variations in a single unit factor? Here we have certain remarkable data as to the eye-color of Drosophila; data that are of great interest with relation to the nature of evolutionary change. This fruit fly has normally a red eye. Some years ago a variation occurred by which the eye lost its color, becoming white, a typical mutation. Somewhat later, another variation came, by which the eye color became eosin. By those wonderfully ingenious methods which the advanced state of knowledge of the genetics of Drosophila have made possible, it was determined that the mutations white and eosin are due to changes in a particular part of a particular chromosome, namely, of the so-called X-chromosome, or chromosome I. And further, it was discovered that the two colors are due to different conditions of the same *locus* of the chromosome; in other words, they represent two different variations of the same unit. Moreover, the normal red color represents a third condition of that same unit.

Somewhat later a fourth condition of this same unit was found, giving a color which lies nearer the red, between the red and eosin; this new color was called cherry. So we have four grades or conditions of this single unit character.

And now, with the minute attention paid to the distinction of these grades of eye color, new grades begin to come fast. In the November number of *Genetics*, Hyde (1916), adds two new grades,

Digitized by Google Original from HARVARD UNIVERSITY

one called "blood," near the extreme red end of the series, the other, called "tinged," near the extreme white end; in fact, from the descriptions it requires careful examination to distinguish these two from red and white, respectively. Thus we have now six grades of this unit. And in the same number of the same journal, Safir (1916) adds another intermediate grade, lying between "tinged" and esoin; this he calls "buff." All these seven grades are diverse conditions of the single unit factor, having its locus in a certain definite spot in the X-chromosome. Such diverse conditions of a single actor are known as multiple allelomorphs.

So, up to date we know from the mutationists' own studies of Drosophila that a single unit factor presents seven gradations of color between white and red, each gradation heritable in the usual Mendelian manner. These grades are the following: (1) Red; (2) blood; (3) cherry; (4) eosin; (5) buff; (6) tinged; (7) white.

Three of these grades have been discovered in the ast five months. It would not require a bold prophet to predict that as the years pass we shall come to know more of these gradations, till all detectible differences of shade have been distinguished, and each shown to be inherited as a Mendelian unit. Considering that the work on Drosophila has been going on only about seven or eight years, this is remarkable progress toward a demonstration that a single unit factor can present as many grades as can be distinguished; that the grades may give a pragmatically continuous series. The extreme selectionist asks only a little more than this.

Besides showing that a unit factor may thus exist in numerous minutely differing grades, this case shows that a heritable variation may occur so small as to be barely detectible. Although the variations do not usually occur in this way, the case presents the conditions which would allow of a gradual transition from one extreme to the other, by means of numerous intermediate conditions. In a population in which were occurring such minute changes as are here shown to be possible, we could get by selection such a continuous series of gradations as Castle describes in

Digitized by Google
Original from
HARVARD UNIVERSITY

his rats. The difference in the two cases is, that in Drosophila variations which are large steps occur as well as do the small ones; and that, according to Castle's conception of the matter, such minute heritable variations occur more frequently in the rat than in Drosophila. But on the showing of the students of Drosophila, there is scarcely any other difference in principle between what happens in Drosophila and what Castle believes to happen in the rat.

2. But as we have seen, the mutationists reject the view that the changes in the coat color of the rat are due to alterations in a single unit factor; they explain this and other cases of the effectiveness of selection on a single character by *multiple modifying factors*. Accepting again their contention, the question is shifted to the nature of such factors. What sort of things are these modifying factors? What is their relation to actual changes in the heritable constitution of organisms?

Our direct experimental knowledge of these "modifying factors" is scanty. What we have comes again mainly from the studies of Drosophila, so that we need not suspect it of being colored in such a way as to favor the selectionist point of view. We find data as to certain known modifying factors by one of the workers on Drosophila, Bridges (1916), in his recent important paper on non-disjunction of the chromosomes. And here we are taken back again to the series of eye colors, and indeed to one particular member of the series, the middle member, called eosin.[8] Bridges tells us that he found a factor whose only effect was to lighten the eosin color in a fly with eosin eyes; this factor indeed nearly or quite turns the eosin eye white. This factor Bridges calls "whiting." Another factor has the effect of lightening the eosin color a little less, giving a sort of cream color; this is called "cream *b*." A third factor dilutes the eosin color not so much; it is called "cream *a*." In addition to these, Bridges tells us that he has discovered *three other* diluters of the eosin color; we will call them the fourth, fifth, and sixth diluters. And finally Bridges tells us of another factor whose only effect

[8] BRIDGES, 1916, p. 148. (See Bibliography.)

Digitized by Google Original from HARVARD UNIVERSITY

is to modify eosin in the direction of a darker color: this factor he calls "dark." None of these factors has any effect save on eosin-eyed flies.

As you see, these things add tremendously to our gradations in eye color. We had already been furnished seven grades, from white to red; now we have seven secondary grades within a single one of these seven primary grades. Our list of gradations of eye color in Drosophila therefore takes now the following form:

Heritable grades of eye color, due to diverse variations of a single unit located in Chromosome I.	Variations that give modifications of the intensity of eosin, but are located in other chromosomes.
1. White	1. Whiting
2. Tinged	2. Cream b
3. Buff	3. Cream a
4. Eosin	4. Fourth diluter
5. Cherry	5. Fifth diluter
6. Blood	6. Sixth diluter
7. Red	7. Dark

Let us hasten to add that these seven new grades are not located in the same unit factor as are the seven primary ones; their loci are in other chromosomes (or possibly in other parts of the same chromosome).

Here again then we have minutely differing conditions of a single shade of color, brought about by seven modifying factors. Bridges makes the following remark concerning them:

> A remarkably close imitation of such a multiple factor case as that of Castle's hooded rats could be concocted with the chief gene eosin for reduced color, and these six diluters which by themselves produce no effect, but which carry the color of eosin through every dilution stage from the dark yellowish pink of the eosin female to a pure white.[9]

Now this is an extremely interesting statement, one that must arouse the keen interest of the student of the method of evolution. In Drosophila we could get the same sort of graded results that Castle does with his rats, only in Drosophila this is by

[9] Bridges, 1916, p. 149. (See Bibliography.)

Digitized by Google Original from HARVARD UNIVERSITY

means of multiple modifying factors, whereas Castle believes that in the rat it is by actual alterations of the hereditary constitution!

But what are these modifying factors? And here we come to the astonishing point. *These modifying factors are themselves alterations in the hereditary constitution.* Bridges leaves no doubt upon this point. He lists and describes them specifically as mutations; as actual changes in the hereditary material.

Where then is the difference in principle between the condition in Drosophila and that in the rat? In Drosophila there occur minute changes in the germinal material, such as to give, so far as our present imperfect knowledge goes, seven diverse grades of a color which is itself only one grade of another series of seven known grades. By means of these graded changes one could obtain, by the mutationist's own statement, the continuously graded results which selection actually gives. What more can the selectionist ask?

There are indeed certain differences in detail, in the notions entertained by the different investigators as to exactly *where* the changes occur. Castle believes that in the rat the changes occur all in one unit—in one chromosomal locus—giving a series like the primary series for eye color in Drosophila. The supporters of multiple modifying factors believe, on the other hand—if we are to accept Bridges' account of such factors as typical (and it is the only account we have)—they believe, I say, that these minute changes have occurred in *some other* part of the germinal material. But this difference is one of mere detail; it does not touch the fundamental question.

This fundamental question is as to the occurrence of these minute changes in the hereditary constitution, and as to the possibility of getting therefrom by selection various grades of a given external characteristic. In this, so far as I can see, there is complete agreement.

Now, doubtless, there is a further diversity in the mental processes of the two sets of men, in that the mutationist thinks of all these numerous grades as after all essentially discontinuous, as a series of steps so minute that the difference between one

Digitized by Google
Original from
HARVARD UNIVERSITY

and the next one is not detectible. His opponent, on the other hand, perhaps thinks of the series as actually continuous. But the difference is not a pragmatical one; when steps become so minute as to be beyond detection, the question whether they exist becomes metaphysical.

To put the case in brief, if the mutationists are to show that the existence of multiple modifying factors has any bearing on the general question of the effectiveness of selection, they must show that such factors are not themselves minute changes in the hereditary constitution. Not only have they made no attempt to do this, but in the only well-examined cases they state squarely that such factors are indeed alterations in the hereditary constitution.

For the inheritance of such factors as Mendelian units, of course absolutely nothing is required save that the location of the change is in a chromosome. No particular degree of magnitude; no unity of any other kind is required.

But there remains one point brought out by the mutationists which is of great importance to the student of the method of evolution. While they must admit, by their own account, that all these grades occur, so that a practically if not actually continuous series can be formed, they of course point out that the changes do not occur in a continuous series. In the eye of Drosophila variation may occur from red to white directly, without any transitional stages; or from any grade to any other; the continuous scale is obtained only by arranging the steps in order. Therefore, it is maintained, evolution may have occurred by such large steps, not by continuous gradations.[10] This is of course a matter deserving of serious consideration. But certain other points must be considered also. First, the very facts known for Drosophila show that there is nothing to prevent a passage from one extreme to the other by minute changes, just as is held to occur by the paleontologists and selectionists, although change by large steps occurs also. Secondly, in such cases as the eye color of Drosophila we are dealing with char-

[10] See particularly the discussion of this point in MORGAN, 1916, p. 7–27. (See Bibliography.)

Digitized by Google
Original from HARVARD UNIVERSITY

acters that are already highly developed. We know for example, that this particular character is formed by the cooperation of many separate parts of diverse chromosomes; it is a highly complex product of evolution. Now, we find that one or another of these parts may suddenly cease to perform its function, so that the red color is not completely formed; there is a sudden change in it; or it may disappear entirely. But is this after all strong evidence that in the original production of this complex character with its numerous underlying functional parts, there was the same change by sudden large steps? Indeed, is it not rather true that such destructive changes in a fully formed character could not be expected to throw light on how that character was built up?

I am not unmindful of the fact that there are a few—but only a very few—cases in which there is indication of a positive addition by a definite step, as when the eosin color is produced in white-eyed stock. But here again the underlying apparatus has before had the power to produce eosin and other colors. The white color was due to the temporary suspension of function in parts of the chromosomal apparatus, and it may be doubted whether the restoration of this function throws light on the way the apparatus was first developed.

To sum up, it appears to me that the work on Drosophila is supplying a complete foundation for evolution through selection of minute gradations. The so-called "multiple allelomorphs" show that a single unit factor may thus exist in a great number of grades; the "multiple modifying factors" show that a visible character may be modified in the finest gradations by alterations in diverse parts of the germinal apparatus. The objections raised by the mutationists to gradual change through selection are breaking down as a result of the thoroughness of the mutationists' own studies. We have already gotten completely rid of the notion that the germinal changes consist only in the dropping out of complete units, or that they are bound to occur in large steps. If the recent rate of progress is maintained, when such an organism as Drosophila has been studied for fifty years, instead of eight or nine, there will be no conceivable gradation

Digitized by Google Original from HARVARD UNIVERSITY

of any character that will not have been detected. The only outstanding difficulty is the fact that large changes occur as well as small ones; this seems perhaps due to the fact that we are witnessing the disintegration of highly developed apparatus in place of its building up.

In all this, except the last point, the work on Drosophila is in agreement with my own observation of gradual variation in Difflugia; with Castle's similar results on the rat; and with the conclusions of paleontologists as to the gradual development of the characteristics of organisms in past ages.

But there is one point in the paleontological conclusions, as set forth in the recent papers by Osborn, which is not in agreement with the experimental and observational results on existing organisms; this I wish to notice briefly. Osborn sets forth that in following given stocks from earlier to later ages, characters arise from minutest beginnings, and pass by continuous gradations to the highly developed condition. This seems in agreement with experimental results, as I have tried here to set them forth. Further, according to Osborn, these developing characters do not show random variations in all directions, but follow a definite course, which might seem to have been in some way predetermined. And this is emphasized by the fact that the same sorts of characters (horns, for example) may arise independently, at different ages, in diverse branches of the same stock, and each follow in later ages the same definite course of development.

It would appear therefore from this that there must be some directing tendency, some inner necessity which drives a developing organ to follow a definite course. Evolution is characterized by Orthogenesis, as this phenomenon has sometimes been called.

Now it appears to me that we do not observe this in the present day experimental work; by selection we can move in more than one direction. I do not mean that the possible variations are not limited by the constitution of the varying organism; they certainly are. But there is no indication, so far as I can see, that the variations push in one determinate direction only.

Now, examining the paleontological summaries further as regards this (I refer to Osborn's papers), we find certain points

Digitized by Google Original from HARVARD UNIVERSITY

that appear to modify seriously, if they do not quite nullify, this conclusion that variations follow a determinate course.

First, we do find that diverse courses are followed by given characters, in diverse branches of a given group; this is particularly true of the characters of shape and proportion, which Osborn calls allometrons. I take it from the descriptions that this is likewise true at times for structural and numerical characters.

A second point which Osborn sets forth is deserving of particular attention. He states, in agreement with Waagen, that in any given geologic stratum, we do find, in addition to characteristics that are in the line of determinate descent, other variations from this line, which are of the sort that constitute what we call at the present time varieties; things that are like the diverse races of Difflugia in my own work. But, say Osborn and Waagen, there is a great difference in principle between these and the others, for those which are in the determinate line of progress persist into the next geologic stratum, while the mere varieties do not. The persistent changes were called by Waagen, mutations (in a sense somewhat diverse from that in which the word is used by de Vries).

Osborn expresses the opinion that these "varieties" may be merely non-heritable modifications.[11] But in our present geologic period we find just such diverging forms, in great number, and we find that their peculiarities *are* heritable; this I emphasized in the introductory part of the present discussion. There is then no reason for supposing that these variations were not heritable in earlier geologic periods; there must have been many races heritably diverse, just as there are now; and these are what Waagen called varieties.

Now since this is so, the only difference between Waagen's mutations and his varieties, is that, on looking backward at them, we find that the former persisted and the latter did not. But this tells us nothing whatever about why the latter did not. It is perfectly possible, so far as these facts go, that it was a

[11] OSBORN, 1915, p. 225. (See Bibliography.)

Digitized by Google Original from HARVARD UNIVERSITY

matter of selection by external conditions; many diverse stocks were present, on an equal footing; some were destroyed, others were not.

What ground then is there for saying that the development of given characters followed a definite course, as if predetermined? The conditions described are exactly what we should require to find if in past ages there were many varied stocks, some of which were preserved by the action of natural selection. Looking back over the series from a later age, we are bound of course to find it a continuous development. If the same characteristics were favorable in successive ages—and there is no reason why they should not be so—then the same sorts of variations would be preserved in those successive ages; a line of development once begun would be continued. And if the same sort of characters are favorable ones in different branches of a family, then similar characters may well arise and follow a similar course of development, in the diverse branches, as Osborn states they do. But at the same time many other heritable variations arise, that are not in the line of progress, and hence are not preserved through selection; these are precisely the "varieties" described by the paleontologists; the diverse races that I have described in Difflugia and Paramecium, and that are found to exist in all organisms. The conditions described by the paleontologists support strongly the theory of evolution by gradual change, but I cannot see that they tend to establish the view that variations show a tendency to follow a definite course, as if predetermined. The paleontologists appear rather to report precisely the conditions which we are bound to find if evolution occurs through the guidance of natural selection operating on a great number of diverse variations, the typical Darwinian scheme.

There is one other point which I wish I had time to take up, but I have not. I will merely attempt to state in a few words my impression of it. This is the point made by Bateson (1914) in his Presidential Address before the British Association, and farther developed by Davenport (1916) in a recent paper: the proposition, namely, that since practically all observed variations are cases of loss and disintegration, we are driven to suppose

Digitized by Google Original from HARVARD UNIVERSITY

that evolution has occurred by loss and disintegration. Davenport combines this idea with the theory that these disintegrating variations follow a definite course, predetermined in large measure by the constitution of the disintegrating material.

There are two points worth consideration in dealing with this theory. The first is one of fact; although it is true that many of the so-called mutations appear to be cases of loss and disintegration, yet there is no indication that this is the case in such effects of selection as have been described by Castle and myself; variations are not limited to any particular direction. Secondly, it appears to me that this conclusion—that because the variations we see are cases of loss and disintegration, therefore evolution must have occurred by loss and disintegration—it appears to me, I say, that this conclusion involves an error in logic, which makes it unworthy of serious consideration. The syllogism which it involves seems something as follows:

1. *Major premise.* Evolution has occurred by progress from the visibly less differentiated in structure to the visibly more differentiated in structure.

2. *Minor premise.* By observation we detect only the visibly less differentiated arising from the visibly more differentiated; we see only a process of decreasing the visible differentiation.

3. *Conclusion.* The visibly more differentiated must have arisen from the visibly less differentiated, by decrease in the visible differentiation of the latter.

The conclusion is absurd; it cannot be drawn save for the fact that while in the two premises we are talking of *visible* differentiation and disintegration, in the conclusion the ground is shifted to mean something entirely different—a sort of inner, invisible, purely theoretical kind of differentiation and simplicity and disintegration. By putting in the word *visible* all the way through, the absurdity is brought to light. All that we can legitimately conclude from the two premises is that we have not seen the process of evolution occurring. If we have seen nothing but loss and disintegration, this is indeed the conclusion that we must draw. But I believe that we cannot assert that this is all that we have seen.

Digitized by Google Original from HARVARD UNIVERSITY

To summarize then what I have obtained from experimental work combined with a survey of the work of others, the impression left is as follows:

1. Experimental and observational study reveals that organisms are composed of great numbers of diverse stocks differing heritably by minute degrees.

2. Sufficiently thorough study shows that minute heritable variations—so minute as to represent practically continuous gradations—occur in many organisms; some reproducing from a single parent others by biparental reproduction.

3. The same thing is reported from paleontological studies.

4. On careful examination we find even that the same thing is revealed by such mutationist work as that on Drosophila; single characters exist in so many grades due to minute alterations in the hereditary constitution as to form a practically continuous series.

5. It is *not* established that heritable changes must be sudden large steps; while these may occur, minute heritable changes are more frequent.

6. It is *not* established that heritable variations follow a definite course as if predetermined; they occur in many directions.

7. It is not established that all heritable changes are by disintegration; although many such do occur, they cannot be considered steps in progressive evolution from the visibly less complex to the visibly more complex.

Evolution according to the typical Darwinian scheme, through the occurrence of many small variations and their guidance by natural selection, is perfectly consistent with what experimental and paleontological studies show us; to me it appears more consistent with the data than does any other theory.

BIBLIOGRAPHY

Bateson, W., 1914. *Address of the President of the British Association for the Advancement of Science.* Science, **40**: 319–333. Bridges, C. B., 1916. *Non-disjunction as proof of the chromosome theory of heredity.* Genetics, **1**: 1–52; 107–163. Castle, W. E., 1915. *Mr. Muller on the constancy of Mendelian characters.* Amer. Nat., **49**: 37–42. Castle, W. E., 1915 *a*. *Some experiments in mass selection.* Amer. Nat., **49**: 713–726. Castle, W. E., 1916. *Can selection cause genetic change?* Amer. Nat., **50**: 248–256. Castle, W. E., 1916 *a*. *Further studies of piebald rats and selection, with observations on gametic coupling.*

Digitized by Google

Original from HARVARD UNIVERSITY

Carnegie Inst. Wash., Pub. 241, Part III: 161–192. Castle, W. E., 1916 b. *Genetics and Eugenics.* Cambridge. Pp. 353. Castle, W. E., 1917. *Piebald rats and multiple factors.* Amer. Nat., **51**: 102–114. Castle, W. E., and Phillips, J. C., 1914. *Piebald rats and selection. An experimental test of the effectiveness of selection and of the theory of gametic purity in Mendelian crosses.* Carnegie Inst. Wash., Publ. 195. Pp. 56. Davenport, C. B., 1916. *The form of evolutionary theory that modern genetical research seems to favor.* Amer. Nat., **50**: 449–465. Hagedoorn, A. L. and Mrs. A. C., 1914. *Studies on variation and selection.* Zeitschr. f. ind. Abst. u. Vererb., **11**: 145–183. Hagedoorn, A. L., and Mrs. A. C., 1917. *New light on blending and Mendelian inheritance.* Amer. Nat., **51**: 189–192. Hyde, R. R., 1916. *Two new members of a sex-linked multiple (sextuple) allelomorph system.* Genetics, **1**: 535–580. Jennings, H. S., 1908. *Heredity, variation and evolution in Protozoa. II. Heredity and variation of size and form in Paramecium, with studies of growth, environmental action and selection.* Proc. Amer. Philos. Soc., **47**: 393–546. Jennings, H. S., 1909. *Heredity and variation in the simplest organisms.* Amer. Nat., **43**: 321–337. Jennings, H. S., 1910. *Experimental evidence on the effectiveness of selection.* Amer. Nat., **44**: 136–145. Jennings, H. S., 1911. *Pure lines in the study of genetics in lower organisms.* Amer. Nat., **45**: 79–89. Jennings, H. S., 1916. *Heredity, variation and the results of selection in the uniparental reproduction of Difflugia corona.* Genetics, **1**: 407–534. MacDowell, E. C., 1915. *Bristle inheritance in Drosophila.* Journ. Exper. Zool., **19**: 61–97. 1916. MacDowell, E. C., *Piebald rats and multiple factors.* Amer. Nat., **50**: 719–742. Morgan, T. H., 1916. *A critique of the theory of evolution.* Pp. 197. Princeton Univ. Press. Morgan, T. H., 1917. *An examination of the so-called process of contamination of genes.* Anat. Record, **11**: 503–504. Osborn, H. F., 1912. *The continuous origin of certain unit characters as observed by a palaeontologist.* Amer. Nat., **46**: 185–206, 249–278. Osborne, H. F., 1915. *Origin of single characters as observed in fossil and living animals and plants.* Amer. Nat., **49**: 193–239. Osborn, H. F., 1916. *Origin and evolution of life upon the earth.* Scientific Monthly, **3**: 5–22; 170–190; 289–307; 313–334; 502–513; 601–614. Pearl, Raymond, 1915. *Seventeen years selection of a character showing sex-linked Mendelian inheritance.* Amer. Nat., **49**: 595–608. Pearl, Raymond, 1916. *Fecundity in the domestic fowl and the selection problem.* Amer. Nat., **50**: 89–105. Pearl, Raymond, 1917. *The selection problem.* Amer. Nat., **51**: 65–91. Reeves, Edna M., 1916. *The inheritance of extra bristles in Drosophila melanogaster Meig.* Univ. Calif. Pub. Zool., **13**: 495–515. Safir, S. R., 1916. *Buff, a new allelomorph of white eye color in Drosophila.* Genetics, **1**: 584–590. Sturtevant, A. H., 1917. *An analysis of the effect of selection on bristle number in a mutant race of Drosophila.* Anat. Record, **11**: 504. Zeleny, C. and Mattoon, E. W., 1915. *The effect of selection upon the "bar-eyes" mutant of Drosophila.* Journ. Exper. Zool., **19**: 515–529.

ETHNOLOGY.—*The Chitimacha of Bayou La Fourche, Louisiana.* DAVID I. BUSHNELL, JR. Bureau of American Ethnology.

Early in the eighteenth century, when the Chitimacha first became clearly known to the European colonists, they occupied two groups of settlements within their rather small territory just west of the mouth of the Mississippi. One group was in the vicinity of Bayou Teche and Grand Lake, on and near the site of the present town of Charenton, St. Mary parish, Louisiana, where some continue to dwell. The second group was

Digitized by Google Original from HARVARD UNIVERSITY

eastward, in the country adjacent to Bayou La Fourche, then known as the river of the Chitimacha. Many, if not all, of the latter removed from their ancient habitat during the years 1718 and 1719, but it is quite evident that other Indians soon occupied the old Chitimacha sites, and among the new arrivals were many Houma, and others from east of the Mississippi. Likewise, it is highly probable that some of the Chitimacha later found their way back to their old homes.[1]

At the present time several families living in Terrebonne and La Fourche parishes, near Bayou La Fourche, claim to be of Chitimacha descent, although they know some of their ancestors to have been Houma, and many have traces of European blood as well. On the following pages are given some of the mannerisms and customs of these people, as related by Abel Billiot, a man about sixty-five years of age, who is known as a Chitimacha, from the village of Point-au-chien in the southeastern part of Terrebonne parish, Louisiana.

HABITATIONS

The primitive form of habitation was constructed and occupied during the past ten years and, according to my informant, the last example was destroyed at the time of the great storm about eight years ago. The houses were built in the following manner: A slight excavation was made to correspond with the floor-space of the future structure. The wall was outlined by a row of posts about three of four inches in diameter and four feet or more in height, placed about two feet apart. Smaller flexible branches and saplings were interwoven between the upright posts. A low conical roof was formed of a frame covered with thick palmetto thatch. A hole was dug in which a quantity of clay and Spanish moss was mixed with water, this serving as plaster for the wall of wattle work. Clam and oyster shells were burned and the lime thus obtained was mixed with water and used to whitewash the inside wall of the

[1] Swanton has discussed this in *Indian tribes of the lower Mississippi Valley*, Bulletin 43, Bureau of American Ethnology, Washington, 1911.

Digitized by Google Original from HARVARD UNIVERSITY

house. On the day this work was to be done all the people of the village gathered, and the walls were completed between sunrise and sunset.[2] The structures were either round or square, and one, much larger than the others, is remembered to have served as a meeting place for the men of the village. The fires were made outside the house. Small shelters are said to have been made of skins.

FOOD

Much food was smoked and so preserved for future use. The method of smoking was this: Four poles were set up, extending between three and four feet above the surface. These were connected at the top by other poles or cords, and to the latter were attached the pieces of meat, the fish, the ducks, and all else that was to be smoked. The fire was made on the ground between the four stakes and no particular kind of wood was required. Many ducks were prepared in this manner, being first skinned, thoroughly cleaned and opened on the back. Everything was so well smoked as not to require more cooking before being eaten.

A hole was made in the ground (probably about the size of a bushel basket) and filled with clams or oysters. These were covered with a thin layer of sand or earth and a fire kindled above. After a certain time the covering was scraped away and the clams and oysters removed and eaten. Neither clams nor oysters are known to have been smoked, they being always plentiful and easily obtained.

Corn was grown and was prepared in various ways. Often it was pounded in a wooden mortar, then passed through a sieve to separate the fine from the coarse particles. The fine meal was mixed with water and allowed to remain over night during which time it would ferment and become sour. The following morning it would be boiled a little, and dried until "it would hold together," then it was eaten. This appears to

[2] This at once suggests a statement made by Adair in reference to the houses of the southern Indians: In one day, they build, daub with their tough mortar mixed with dry grass, and thoroughly finish, a good commodious house.

Digitized by Google Original from HARVARD UNIVERSITY

have been a favorite method of preparing the meal, the sour taste being relished. This was sometimes eaten with a sirup. Again, corn was allowed to ripen on the cob, and to become quite dry, before being shelled. Later the grains were parched by being mixed with hot ashes of a wood fire. The parched grains were then pounded in a wooden mortar, passed through a sieve, and eaten mixed with water.

Turtles were relished, and likewise their eggs, but the flesh was never smoked. Alligator eggs were eaten, but not the flesh unless other food was scarce. Salt was not used by the old people, and it is not cared for at the present time.

Berries and wild fruits are eaten when ripe, but are never dried.

DRESS AND PERSONAL DECORATION

The men, until quite recently, wore their hair long but did not plait it. The manner of cutting and shaping it is not remembered.

Formerly the hands, neck, and cheeks, were tattooed, the colors used being red and black. The former was derived from the juice of the giant rag weed (*Ambrosia trifida*); the latter was soot produced by burning yellow pine.

Small shells were perforated and strung as necklaces. Other shells were worked and pieces were fashioned into beads.

ARTS AND INDUSTRIES

Bowls, spoons, and paddles for stirring food were made of wood. The Chitimacha word for bowl is *Gah-mail'*. Mortars and pestles were made for use in preparing corn, and so forth.

A piece of hard stone is used with a steel to "strike fire," decayed dry wood, or a bit of old hide, being used to ignite with the spark.

The ancient, and still practiced, method of dressing skins as described by Abel Billiot is this: If possible, the skin as soon as removed, is stretched in a frame, or fastened to a flat surface, and in this position is allowed to dry. A frame is then constructed

Digitized by Google Original from HARVARD UNIVERSITY

of four poles, two being set in the ground, parallel and some three or four feet apart, the others being arranged in a horizontal position attached to the former. Within the rectangular space thus formed the skin is stretched and securily fastened. The frame holding the skin is not stood in a vertical position, but at an angle of about thirty degrees. A small fire of palmetto wood is made on the ground below it so that much smoke is produced. Some of the brain of the animal is then rubbed over the upper surface of the skin, which is thoroughly scraped with a chisel-shaped implement made of a piece of hard wood beveled at one end. After this surface has been sufficiently scraped the skin is turned over and the other side is treated with brains and rubbed and scraped in the same manner. During the entire process the skin is kept quite warm by the fire beneath it, and smoke is allowed to rise against it. After the scraping and rubbing, which has resulted in the removal of all hair and wool from one side and all particles of flesh from the other, the skin is quite soft and white. Sufficient oil, from the brain which has been rubbed into the skin, remains to keep it pliable. No other method of dressing skins is known to this man.[3]

Pottery vessels have been made and used within recent years, and are remembered by my informant. A blue clay found near his village was used for the purpose. Mixed with it naturally, was a sufficient quantity of sand, and neither sand nor pulverized shell was added. The clay having been obtained was worked in a wooden mortar, water being added to make a pasty mass. When the clay was of a proper consistency it was modelled into the desired vessel, which was then put in a shady place and allowed to remain two or three weeks before being baked. Tobacco pipes were, and are now, made in this manner. Before being placed in the fire, and after having become thoroughly dry, the vessel was smoothed by scraping with a shell or thin

[3] This method of preparing skins is more suggestive of the north than of the south, and differs greatly from the custom of the Choctaw who live just north of Lake Pontchartrain in St. Tammany parish. BUSHNELL, *The Choctaw of Bayou Lacomb, St. Tammany Parish, Louisiana.* Bulletin 48, Bureau of American Ethnology, Washington, pp. 11–12, 1909.

Digitized by Google Original from HARVARD UNIVERSITY

piece of hard wood, and any incised decorations were added at this time. Brown clay was not considered good for pottery making, and grease was never used to darken the ware. Spoons are made from cow horns.

Baskets are made from both split cane and the stems of palmetto, native dyes being used. Three colors are made and used by these people, yellow, red, and black, these added to the natural material giving them four shades to combine in their basket work. The yellow dye is derived from the roots of l'anze, which is known locally as paciance. This is a dock, probably *Rumex crispus* L. The root is crushed and pounded while fresh and is not allowed to become dry. The crushed roots are then placed in a kettle of water and allowed to boil. The split cane is also put in the kettle and soon becomes a brilliant yellow. If a red is desired the material is first dyed yellow, as stated, and is then removed from the kettle and allowed to remain over night in a protected spot, away from the wind. In the morning it is again put in the same liquid to which is added a small quantity of lime made by burning clam or oyster shells. It is again boiled and now turns red, caused by the action of the strong alkali. The shade of red may be governed by the density of the yellow dye, and by the length of time it remains in the alkali solution. Black dye is made by boiling the bark of the maple or live oak in water.

Cords or ropes are still made by twisting back moss. Only *black* moss will serve the purpose. A quantity is obtained and two persons work with it, twisting in opposite directions. After the cord is some twenty or thirty feet in length it is doubled and again twisted, this time very tightly.

Dugouts or pirogues are made of a single log of cypress. Other woods are sometimes used, but cypress is the favorite. Light canoes were formerly made by covering a frame of wood with skins or bark.

HUNTING AND FISHING

Blowguns were used in hunting small game and birds. They were made of pieces of cane from 5 to 7 feet in length.

Digitized by Google

Original from
HARVARD UNIVERSITY

Formerly the cane was split, the joints hollowed out and the inside smoothed, then the two pieces were bound together. More recently a piece of wire has been used to burn the joints. The darts were wrapped for a distance of about two inches with cotton or frayed cloth. Bows and arrows were used by the "old people," but not since they have been able to obtain guns and powder from the whites. Fish are secured by spearing them from a dugout, usually when the sun is shining brightly. Traps for catching fish are unknown to my informant, but nets are known to have been used.

Little could be learned respecting the social culture of these people, the native names of people and places having been forgotten. The myths and legends are no longer remembered, although several very old persons, now living east of the bayou near the coast, may retain some knowledge of their ancient tribal organization. All will soon be lost.

Digitized by Google

Original from
HARVARD UNIVERSITY

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

GEOLOGY.—*The Cleveland Gas Field, Cuyahoga County, Ohio, with a study of rock pressure.* G. SHERBURNE ROGERS. U. S. Geological Survey Bulletin 661–A. Pp. 68, with 2 plates and 13 figures. 1917.

Most of the wells in the Cleveland gas field, which is located in the westerly suburbs of the City of Cleveland, are from 2500 to 2900 feet deep and draw their supplies from the so-called Clinton sand. The structure of the region is, broadly speaking, monoclinal, the formations outcropping in the western part of Ohio and dipping to the east beneath the great Appalachian Coal Basin. The Clinton sand itself does not outcrop, however, but feathers out in the central part of the state, and the Cleveland field and other important oil and gas fields to the south occupy a belt along the upper or thinning edge of the sand. The accumulation of the gas at Cleveland has been influenced also by structural considerations, the field being roughly coincident with a broad gentle bulge or nose on the monoclinal slope, and has been affected locally by the porosity or texture of the sand.

Owing to the very rapid growth of the field which was started in 1912, and which in 1915 contributed about 40 per cent of the Ohio production, the records of pressure and production decline are unusually complete and afford an interesting study. It appears that in any large group of wells there is a fairly close average relation between rock pressure and production. Hence by studying the pressure decline in any group it is possible to predict in advance of drilling the probable flow or volume of a new well in that group. If desired, the estimate may be evaluated according to the theory of probability and the number of chances in a hundred that the flow will not exceed a given figure may be calculated. Although the actual figures cited of course hold only in the Cleveland field the principles discussed should be applicable in many areas. G. S. R.

Digitized by Google
Original from
HARVARD UNIVERSITY

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 316th meeting was held at the Cosmos Club, February 28, 1917.

INFORMAL COMMUNICATIONS

FRANK J. KATZ: *Age of the Worcester phyllite.* (No abstract.)

REGULAR PROGRAM

R. V. A. MILLS and R. C. WELLS: *The evaporation of water at depth by natural gases.* During the production of petroleum and natural gas in the Appalachian fields the associated waters undergo a definite order of change in the proportions of their dissolved constituents. Along with other gases, carbon dioxide escapes from solution while calcium carbonate and ferrous carbonate are deposited in the wells and in the interstices of the oil and gas bearing rocks. Concentration is brought about by the removal of water as moisture in the escaping gases and at the same time salt is lost from solution. The composition of the salt deposit is approximately: NaCl 94 to 99.5 per cent, $MgCl_2$ 2.5 to 0 per cent, $CaCl_2$ 3.0 to 0 per cent, and $CaCO_3$ 0.5 to 0 per cent. The composition of this salt was found by analyses of salt deposits collected from oil and gas wells and gas line pressure regulators; and this composition agrees closely with the composition of the salt deposit that can be predicated from the changes in the composition of the waters during their concentration under known conditions of production. Some of the pressure regulators, in which gas pressures are reduced from line pressures to distributing pressures, are several miles distant from the wells from which gas is derived. Analyses of salt deposited in the wells and regulators bear a striking resemblance to analyses of salt from Louisiana salt domes and salt beds in New York, Michigan, and Kansas.

Comparisons of analyses of Appalachian oil-field waters from different stratigraphic horizons in the same localities indicate that salt of the same general composition has been lost from solution during natural concentration. The investigators are convinced that the evaporative action of natural gas has been an important geologic factor in the changes which many deep-seated waters have undergone. During geologic time enormous volumes of natural gas have passed

Digitized by Google Original from HARVARD UNIVERSITY

through the sediments, so that sea water, which was interstitially included in marine sediments, has probably undergone a like mode of concentration.

Judging from experimental results obtained with illuminating gas, methane should be no exception among gases in its capacity to take up and transmit moisture. The amount of moisture in a given volume of gas under any given conditions can be calculated from the vapor pressure of solutions of salt in water. Conditions favorable for the transmission of water as vapor in porous rocks may be created by the chemical production of gases, by the expansion of compressed gases, by the release of gases held in solution in oil or water by pressure, and by the vaporization of liquefied gases.

Salt and brines are commonly found near occurrences of gas and petroleum, so that gases may have been effective in the evaporation of the solutions which yielded the salt. In fact, salt domes may be the result of evaporation and crystallization brought about by the passage of expanding natural gas which has carried off moisture as vapor and possibly also has cooled the solutions from which salt was crystallized.

The great changes effected in the waters of the Appalachian fields during the production of oil and gas were explained in part by the mode of occurrence of oil-gas-water mixtures in this region of low dips. The occurrence of gas and oil overlying water was attributed in part to induced segregation brought about during movements through the pay sands after production was begun.

M. I. Goldman: *Results of the microscopic examination of some rocks from the oil fields of southeastern Ohio.* This is a preliminary study and the conclusions are therefore only tentative. The primary object of the investigation was to find any characters of the rocks that might bear on the distribution of oil in them. As the work progressed it appeared that, in addition, light might be thrown on some of the early stages of metamorphism and their relation to geologic conditions It was found impracticable to make determinations of pore space because, by the tearing out of soft minerals, and in other ways, holes are produced in grinding the thin section. The investigation was therefore limited to the study of epigenetic minerals. The following were recognized: *Quartz* as a secondary growth around the original grains and in continuous crystallographic orientation with them, was found in almost all not too argillaceous sandstones. The approach to quartzite was in general greatest in the deepest beds, though this factor was very variable. *Kaolinite* in fine crystalline aggregates filling the pore spaces. This is known as a common mineral in sandstones. *Calcite* and other carbonates. These seemed to be particularly abundant in older fields or fields in which wells were very numerous, thus indicating a relation to recent circulation of ground, waters resulting from the drilling. *Sulphides* (pyrite or marcasite) were scarce in this field and occurred mainly in the clays associated with carbonaceous matter, a common syngenetic relationship. It is significant, however, as illustrating the mineralogic

Digitized by Google

Original from HARVARD UNIVERSITY

and chemical individuality of different fields that, outside of this field, in Ohio and Pennsylvania they are sometimes common in large aggregations in sandstones. *Chert* and *opal* growths are scarce and difficult to recognize, and received no special attention. *Micas* are probably the most significant of the secondary minerals. They are of various species and types and their differentiation from syngenetic micas is difficult, being based mainly on habit and distribution. These most require further study, but so far as can at present be stated their development seems to be, like that of the carbonates, related to circulation resulting from opening up of wells. There were some indications that the development of secondary quartz and sulphides might also be related to this feature.

A final interesting metamorphic character is incipient granulation, apparently by pressure and followed by recementing of sand grains in a few of the deepest beds, especially in one sample at a depth of 2230 feet.

Of the relation of oil to these factors nothing can as yet be said. The most porous, which are generally the purest and coarsest sandstones, naturally form the best reservoirs, but they are often barren. A dark brown stain, believed to be due to oil, is also found related to the occurrence of carbonaceous matter in some of the clays, a relationship well recognized in the oil shales of the west.

The 317th meeting was held at the Cosmos Club, March 14, 1917.

REGULAR PROGRAM

Harry Fielding Reid: *The distribution of land and water on the earth.* (No abstract.) Discussed by Eakin, Umpleby, and W. J. Humphreys.

William Bowie: *Some evidences of isostasy.* The first exhaustive test of the theory of isostasy was made by Prof. John F. Hayford, about ten years ago, while he was in charge of the geodetic work of the United States Coast and Geodetic Survey. For this purpose he used the connected triangulation of the United States and the astronomic observations made at several hundred triangulation stations. His results were surprisingly convincing that isostasy existed to a remarkable degree.

The speaker reviewed briefly the evidences of isostasy, as given by the most recent investigations of the subject by the Coast and Geodetic Survey. In these investigations there were used 219 gravity stations in the United States, 42 in Canada, 73 in India, and 40 other stations, which were principally in Europe. The conclusion reached by the speaker was that isostasy, for areas as large as the United States, is perfect and that it is practically perfect for areas of a much smaller size; such, for instance, as the state of Texas, or an area even smaller.

It is impossible to tell, with our present data, whether the local deviations from normal gravity, called anomalies, are due to a lack of

Digitized by Google Original from HARVARD UNIVERSITY

isostatic compensation locally or whether they are due to abnormally heavy or light materials near the station but in the region below sea level. This local deviation from normal in the gravity may be due in part to an actual deviation from perfect isostasy and in part to the abnormal densities near the surface.

It is reasonably certain that the anomalies cannot be due entirely to the use of erroneous densities for the topography, that is, the material which is above sea level, nor to the method of distributing the compensation with respect to depth. The largest anomaly, which is 0.093 dyne, is at Seattle and this is the equivalent of 3000 feet of material of normal density. As a matter of fact, Seattle is located near the coast and that station has an elevation of only 74 meters. We must, therefore, conclude that the anomaly at this station is caused by conditions which exist below sea level.

It has been found, as a result of the investigations, that a regional distribution of compensation out to a distance of 58.8 kilometers from a station is just as probable as the local distribution of the compensation. It has also been found that a regional distribution out to a distance of about 167 kilometers from the station is not so probable as the regional distribution to the smaller distance mentioned above or as a local distribution. There is no relation between the gravity anomalies and the character of the topography. There is, however, a decided relation between the gravity anomalies and certain geological formations. There is a very strong tendency for gravity to be light and the anomalies negative for stations located on the Cenozoic formation and the opposite is true for stations on the pre-Cambrian formations.

If the compensation were assumed to be distributed uniformly with respect to depth, then the depth of compensation, as derived from gravity data alone, is 95 kilometers. This agrees fairly well with the depth obtained from deflections of the vertical, but there is no geodetic evidence that the compensation is distributed uniformly with respect to depth. It is possible that some other method of distribution is the true one but it is difficult or practically impossible ever to discover, at least from geodetic evidence, what the true method of distribution is.

In the other countries data as detailed as for the United States were not available, but such tests as could be made indicated that isostasy in them was about as perfect as in this country. It is hoped that geodesists in the other countries will reduce their gravity stations for topography and isostasy by the same method as that used by the United States Coast and Geodetic Survey or by a similar one in order that more exhaustive tests may be made of the isostatic condition throughout the world.

Discussed by WHITE.

DAVID WHITE: *Discussion of gravity anomalies from the stratigraphic standpoint.* (No abstract.) Discussed by WILLIAM BOWIE.

H. E. MERWIN, *Secretary.*

Digitized by Google Original from HARVARD UNIVERSITY

THE BOTANICAL SOCIETY OF WASHINGTON

The 119th regular meeting of the Society was held in the Crystal Dining Room of the Ebbitt Hotel, Wednesday evening, March 14, 1917. Seventy-four members and sixty-five guests were present. Mr. T. H. KEARNEY, President of the Society, presided. Mr. A. S. HITCHCOCK, the retiring President, delivered an address on *Taxonomic botany and the Washington botanist*. A full text of this address appears elsewhere in this Journal.[1]

The 120th regular meeting of the Society was held in the Assembly Hall of the Cosmos Club at 8.00 p.m., Tuesday, April 3, 1917; eighteen members and one guest present.

Under "Brief Notes" Dr. W. H. EVANS showed a Lummière plate of a pineapple field in Hawaii, part of which had been sprayed with an 8 per cent solution of ferrous sulphate. The sprayed portion of the field was a deep green color and produced an excellent crop while the unsprayed portion was yellow or pale green and the crop practically a failure.

The regular program consisted of the following papers:

The control of the white pine blister rust: HAVEN METCALF. (Illustrated with lantern slides.) The white pine blister rust apparently originated in Asia and spread into Europe upon *Pinus cembra*. When the white pine (*Pinus strobus*) was introduced into Europe it proved to be subject to the disease. The first record of importation of white pine transplants from Europe to the United States dates back only to 1899. The disease was first reported in America in 1906. Since that date enormous quantities of diseased nursery stock have been imported. The pathologists and foresters of New England and the Middle Atlantic States discouraged importation of white pine seedlings after June, 1909, and importations was made illegal in 1912.

The disease has spread more rapidly and posessed greater virulence in New England than it did in Europe. At first it was hoped the disease would prove to be only a disease of nursery stock but at several points in New England it is attacking large trees. Inspection of nursery stock for blister rust is largely futile since the rust often incubates in pine tissue for many years before becoming apparent by distorting the growth or by fruiting. According to Ravn this incubation period may be as long as 20 years. As alternate hosts the black currants, both wild and cultivated, are particularly subject to the disease, and in areas of general infection are reliable indicators of its presence. On Ribes the disease is generally prevalent throughout New England, which means that the actual infection of pine is much more general than is shown at present.

[1] 7: 251. 1917.

Digitized by Google
Original from HARVARD UNIVERSITY

The control of the disease in America presents three separate problems: (1) In the territory west of the Mississippi river the disease is not known to occur. During the coming season an extensive survey will be made of these states to determine whether the disease is or is not present. If it has not been carried into this territory on nursery stock, there is little possibility of its getting in by natural means. If the disease should once become established under western forest conditions, its control would be hopeless. All 5-needle pines of this area, including the very valuable sugar pine and western white pine, are subject to the disease, and many species of wild Ribes are common. (2) In the states between the Mississippi and the Hudson River, there is an area about 30 miles square in Minnesota and Wisconsin, northeast of St. Paul, which is heavily infected. In Indiana, Ohio, Pennsylvania, and New Jersey the disease has been found in a few nurseries and plantations, and is now believed to have been eradicated. In New York it has been found in both nurseries and plantations, and largely eradicated. (3) In New England the infection is so general that the only hope of successful growing of white pine in the future lies in the elimination of the alternate host of the disease. Whether such elimination can be made at a sufficiently low cost to be profitable has not been determined. Probably in localities where Ribes occur sparsely, as in Connecticut and Rhode Island, a great deal can be accomplished.

Dr. Metcalf called attention to the larger problem of free trade in plant diseases and in insect pests. He questioned it as a sound national policy and doubted if the entire *importing* nursery business is worth as much to the country as the damage which it causes. Not a single plant disease or insect pest that has once become established in this country has been eradicated or is ever likely to be. No matter how well controlled, it remains in every case a permanent tax against our economic resources. To safeguard the country against further invasions is therefore most important.

Technique for the study of the white pine blister rust: R. H. COLLEY. (Illustrated with lantern slides.) The study of the blister rust requires a knowledge of the anatomy of the hosts and of the life history and morphology of the fungus itself, since cultural studies are necessarily confined to the host plants. The best available methods of killing, embedding, and sectioning are being employed in working out the relation of host and parasite. Flemming's killing solution followed by Haidenhain's iron alum-haematoxylin and a counter stain of lichtgrün or orange G have proved very satisfactory for both host and parasite in both the pine and the currant stages. For quick sectioning of doubtful specimens previous to diagnosis the freezing microtome has been very satisfactory. Excellent preparations can be cut, stained, and mounted in two hours. The most satisfactory stains seem to be safranin and lichtgrün. When correctly handled, the hyphae and haustoria of the rust are sufficiently characteristic to be of positive diagnostic value, even before spores are formed.

Digitized by Google Original from HARVARD UNIVERSITY

Some natural groups in aspergillus: CHARLES THOM. (Illustrated with cultures.) A large number of strains obtained in cultures of Aspergillus fall into a series of natural groups. In these groups certain general morphological and physiological characters prevail. The differences between the members of the groups are for the most part quantitative rather than qualitative. In the *Aspergillus niger* group, the amount or intensity of color varies markedly among the individuals, other characters remaining the same. Individuals with exactly the same color and morphology show markedly different physiological activities. The differences between these latter physiological forms is certainly as important as the mere difference in the amount of color secreted in the spore, which difference has been commonly accepted as a basis for specific description.

Another great group may be made of the forms giving the morphology of *Aspergillus flavus.* In this series again the same condition exists as noted in the *Aspergillus niger* group. *Aspergillus fumigatus* and *A. nidulans* form two closely related series of organisms.

Several similar series may be made but the point clearly brought out is that there is evidence of mutation among these forms in which a single morphological or physiological character appears to separate one strain from the typical strain of the series as at present described. Within each group differences are easily recognizable, some of which are determinable only by chemical or physiological means. The solution of the taxonomic difficulty offered is that each group shall be designated by the name of one of its well-known species excepting when particular strains have become important economically or physiologically, and must therefore receive some further form of identification and description.

H. L. SHANTZ, *Corresponding Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 569th regular meeting of the Society was held in the Assembly Hall of the Cosmos Club, Saturday, April 7, 1917; called to order at 8 p.m. by President HAY; 45 persons in attendance.

Under the heading "Brief notes and exhibition of specimens" Dr. R. W. SHUFELDT exhibited lantern slides of living California quail, calling attention to their rapidly diminishing numbers. Dr. L. O. HOWARD called attention to a specimen that had lately come to his notice, the cocoon of a Cecropia moth containing moonstones. He expressed the opinion that they had been placed there by a thieving crow or bluejay. Mr. A. W. WETMORE stated in this connection that he has seen bluejays insert small acorns and kernels of corn into large cocoons.

The regular program consisted of two communications:

ALEXANDER WETMORE and FRANCIS HARPER: *A note on the hibernation of the mud-turtle.* The authors reported finding a specimen of *Kinosternon pennsylvanicum* shortly after it had left its underground

Digitized by Google Original from HARVARD UNIVERSITY

winter-quarters. The hole from which it had emerged was beneath a dense growth of green-briar in an old field, and about 50 yards from the nearest marsh. The burrow was 9½ inches deep, and was open save at the lower end, where the animal had apparently lain encased in a mass of mud. The actions and condition of the turtle after being placed in water were described in detail, and an account of a post-mortem examination of the viscera was given. Messrs. W. P. Hay, M. W. Lyon, Jr., and Wm. Palmer took part in the duscussion.

A. S. Hitchcock: *Botanizing in the Hawaiian Islands.* The speaker visited the Hawaiian Islands during five months of 1916. He said the trade winds deposit their moisture upon the eastern and northern mountains of all the islands, furnishing the conditions for rain forests in these regions. The lee side of the islands is dry even to aridity. An interesting feature of the wet areas at or near the summit of the ridges are the open bogs. These bogs are devoid of trees and large shrubs, but contain a variety of low shrubs and herbaceous plants. Many species form tussocks, or hemispherical masses, raised above the level of the bog. The most conspicuous of the tussocks is made by a sedge (*Oreobolus furcatus*, Mann). Three peculiar species of Panicum are tussock-formers (*Panicum monticola* Hillebr., *P. imbricatum* Hillebr., and *P. isachnoides* Munro). Owing to the extreme isolation of the islands, the flora is peculiar and interesting. The family Lobeliaceae is represented by about 100 species, belonging to about 6 genera. Many species are arboreous, forming trunks 10 to 20 feet or in a few cases as much as 40 feet high. The crown of foliage gives the aspect of a palm. The grasses, disregarding the introduced species, are not numerous, but several are peculiar. The genus Eragrostis is represented by numerous species. A rare species of Poa (*Poa siphonoglossa* Hack.) produces leafless rushlike stems, as much as 15 feet long. The talk was illustrated by maps, botanical specimens, and numerous lantern slide views of various features of the islands.

M. W. Lyon, Jr., *Recording Secretary.*

Digitized by Google Original from HARVARD UNIVERSITY

ANNOUNCEMENT OF MEETINGS OF THE ACADEMY AND AFFILIATED SOCIETIES[1]

Saturday, May 19: The Biological Society, at the Cosmos Club, at 8 p.m.

Wednesday, May 23: The Geological Society, at the Cosmos Club, at 8 p.m.

Saturday, May 26: The Philosophical Society, at the Cosmos Club, at 8.15 p.m. Program:

L. W. B. REES, Royal Flying Corps: *Some difficulties encountered by the military aviator.* 30 minutes.

W. R. BLAIR: *Aerology in aid of aeronautics.* (Illustrated.) 20 minutes.

[1] The programs of the meetings of the affiliated societies will appear on this page if sent to the editors by the thirteenth and twenty-seventh day of each month.

Digitized by Google

Original from
HARVARD UNIVERSITY

CONTENTS

Original Papers

Page

Geology.—On the terms aphrolith and dermolith. T. A. Jaggar........ 277

Genetics.—Observed changes in hereditary characters in relation to evolution. H. S. Jennings.. 281

Ethnology.—The Chitimacha of Bayou La Fourche, Louisiana. David I. Bushnell, Jr.. 304

Abstracts

Geology.. 308

Proceedings

The Geological Society of Washington........................... 309

The Botanical Society of Washington............................. 313

The Biological Society of Washington............................ 315

Digitized by Google

Original from HARVARD UNIVERSITY

L.S02.120.146.230.13

LIBRARY
PEABODY MUSEUM
RECEIVED
NOV 3 1955

Vol. VII

No. 14

August 19, 1917

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

BOARD OF EDITORS

N. Ernest Dorsey
BUREAU OF STANDARDS

Adolph Knopf
GEOLOGICAL SURVEY

A. S. Hitchcock
BUREAU OF PLANT INDUSTRY

PUBLISHED SEMI-MONTHLY
EXCEPT IN JULY, AUGUST, AND SEPTEMBER, WHEN MONTHLY

BY THE

WASHINGTON ACADEMY OF SCIENCES

OFFICE OF PUBLICATION
WILLIAMS & WILKINS COMPANY
BALTIMORE, MD.

Entered as second-class matter July 14, 1911, at the post office at Baltimore, Maryland, under the Act of July 16, 1894

Digitized by Google

Original from
HARVARD UNIVERSITY

Journal of the Washington Academy of Sciences

This JOURNAL, the official organ of the Washington Academy of Sciences, aims to present a brief record of current scientific work in Washington. To this end it publishes: (1) short original papers, written or communicated by members of the Academy; (2) a complete list of references to current scientific articles published in or emanating from Washington; (3) short abstracts of certain of these articles; (4) proceedings and programs of meetings of the Academy and affiliated Societies; (5) notes of events connected with the scientific life of Washington. The JOURNAL is issued semi-monthly, on the fourth and nineteenth of each month, except during the summer when it appears on the nineteenth only. Volumes correspond to calendar years. Prompt publication is an essential feature; a manuscript reaching the editors on the second or the seventeenth of the month will ordinarily appear, on request from the author, in the next issue of the JOURNAL.

Manuscripts may be sent to any member of the Board of Editors; they should be clearly typewritten and in suitable form for printing without essential changes. The editors cannot undertake to do more than correct obvious minor errors. References should appear only as footnotes and should include year of publication.

Illustrations will be used only when necessary and will be confined to text figures or diagrams of simple character. The editors, at their discretion, may call upon an author to defray the cost of his illustrations, although no charge will be made for printing from a suitable cut supplied with the manuscript.

Proof.—In order to facilitate prompt publication no proof will be sent to authors unless requested. It is urged that manuscript be submitted in final form; the editors will exercise due care in seeing that copy is followed.

Authors' Copies and Reprints.—On request the author of an original article will receive gratis ten copies of the number containing his contribution and as many additional copies as he may desire at five cents each. Reprints will be furnished at the following schedule of prices:

	4 pp.	8 pp.	12 pp.	16 pp.
50 copies	$1.08	$1.95	$2.93	$3.80
100 copies	1.30	2.40	3.60	4.70
Additional copies, per 100	.45	.90	1.35	1.70

Covers bearing the name of the author and title of the article, with inclusive pagination and date of issue, will be $2.00 for the first 100. Additional covers $1.00 per 100.

As an author may not see proof, his request for extra copies or reprints should invariably be attached to the first page of his manuscript.

The rate of Subscription per volume is	$6.00*
Semi-monthly numbers	.25
Monthly numbers	.50

Remittances should be made payable to "Washington Academy of Sciences," and addressed to the Treasurer, William Bowie, Coast and Geodetic Survey, Washington, D. C., to Williams & Wilkins Company, 2419-2421 Greenmount Ave., Baltimore, Md., or to the European Agents.

European Agents: William Wesley & Son, 28 Essex St., Strand, London, and Mayer and Müller, Prinz Louis-Ferdinand Str., Berlin.

Exchanges.—The JOURNAL does not exchange with other publications.

Missing Numbers will be replaced without charge, provided that claim is made within thirty days after date of the following issue.

* Volume I, however, from July 19, 1911, to December 19, 1911, will be sent for $3.00. Special rates are given to members of scientific societies affiliated with the Academy.

THE WAVERLY PRESS
BALTIMORE, U. S. A.

Digitized by Google
Original from
HARVARD UNIVERSITY

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

Vol. VII — AUGUST 19, 1917 — No. 14

PHYSICS.—*Note on the vibration frequencies of elastic systems.* M. D. Hersey, Bureau of Standards. (Communicated by Louis A. Fischer.)

Introduction. This paper deals with the free vibrations of perfectly elastic bodies. Damping and forced vibrations are excluded from consideration. The purpose is to present the most complete statement, regarding the vibration frequencies of such bodies, that is possible in advance of any knowledge of the geometrical shape of the bodies.

The paper is referred to the attention particularly of persons engaged in acoustics, or in the development of time-keeping devices, or in problems of engineering construction where resonance has to be avoided. Still others, however, may find the paper suggestive in showing what can be done by combining dimensional reasoning with ordinary physical reasoning, in cases where either one alone would be fruitless.

The reasoning is analogous to that of a previous paper entitled The Theory of the Stiffness of Elastic Systems,[1] to which it may be regarded as a sequel, and to which reference must be made for the general conceptions and definitions involved. For convenience, however, the following statement of notation is given:

$$\theta = \text{temperature}$$

$$E = \text{Young's modulus}; \quad \alpha = \frac{1}{E}\frac{dE}{d\theta}$$

[1] Journ. Wash. Acad. Sci., **6**: 569–575. 1916.

Digitized by Google — Original from HARVARD UNIVERSITY

μ = shear modulus; $\beta = \frac{1}{\mu}\frac{d\mu}{d\theta}$

L = length; $\gamma = \frac{1}{L}\frac{dL}{d\theta}$

m = mass; ρ = density

σ = Poisson's ratio

$\Phi = \Phi(\sigma)$; $\Phi' = \frac{d}{d\sigma}\Phi(\sigma)$; etc.

$F = F(R, \sigma)$; $F' = \frac{\partial}{\partial\sigma}F(R, \sigma)$

$R = \frac{m_1}{m_1 + m_2}$; $\eta = \frac{S_1}{S_1 + S_2}$

Subscripts 1 and 2 refer to the members of a coupled system.

S = stiffness (ratio force to displacement)

S_t = torsional stiffness (ratio moment to angle)

n = frequency of free vibration

$\dot{n} = \frac{1}{n}\frac{dn}{d\theta}$; $\dot{S} = \frac{1}{S}\frac{dS}{d\theta}$; etc.

c, C, C_t, C_1, C_2, C_{12} = dimensionless "shape factors," i.e., constants fixed by Poisson's ratio and the generalized shape.

The most important results of this paper are to be found in the four formulas (1), (4), (11), and (12), giving respectively the frequency of a single body, the change in frequency with temperature, the frequency of a coupled system, and the change in this frequency with temperature.

General formulas for frequency of a single body. The vibration frequency for all bodies of the same generalized shape (it will be recalled that this implies not only geometrical similarity but also a similar distribution of density and the other properties of the material) may be written

$$\left.\begin{aligned} n &= \frac{1}{L}\sqrt{\frac{E}{\rho}}\,\Phi_0(\sigma) = \frac{1}{L}\sqrt{\frac{\mu}{\rho}}\,\Psi_0(\sigma) \\ &= \sqrt{\frac{LE}{m}}\,\Phi(\sigma) = \sqrt{\frac{L\mu}{m}}\,\Psi(\sigma) \end{aligned}\right\} \tag{1}$$

Digitized by Google Original from HARVARD UNIVERSITY

The first two results come at once from dimensional reasoning on the assumption that the absolute size L, the density ρ, together with any two of the three elastic constants E, μ, and σ, form a complete set of independent variables. Those two results, ex cept for the explicit mention of Poisson's ratio, will be familiar to any one who has consulted Lord Rayleigh's writings on Sound. The transition to the last two results is obvious, and these will be more useful for some of the present purposes, because they involve a smaller number of quantities that are affected by temperature. This happens because of the physical fact that the mass of a body does not sensibly alter with temperature, whereas both the length and density do. The functions Φ_0, Φ, etc., are unknown, but if necessary could be determined by model experiments; thus, for example, Φ_0 would be found by plotting observed values of $n\, L \sqrt{\frac{\rho}{E}}$ against known values of σ.

General formula for change in frequency of a single body with temperature. Differentiating the second part of (**1**) logarithmically, treating m as a constant, and simplifying mathematically without introducing any further physical information, gives

$$\left.\begin{aligned} \dot{n} &= \frac{\Phi'}{\Phi}\,\frac{d\sigma}{d\theta} + \tfrac{1}{2}\,(\alpha+\gamma) \\ &= \frac{\Psi'}{\Psi}\,\frac{d\sigma}{d\theta} + \tfrac{1}{2}\,(\beta+\gamma) \end{aligned}\right\} \qquad (2)$$

In case the first term vanishes, a simple result is already available. This will happen for pure bending or stretching, for pure twisting or shearing, and for materials, if any such exist, in which Poisson's ratio does not change with temperature. For, with pure bending etc., Φ is constant, so that $\dot{n} = \frac{1}{2}\,(\alpha + \gamma)$; while, with pure twisting, etc., Ψ is constant, so that $\dot{n} = \frac{1}{2}\,(\beta + \gamma)$. In general, however, some physical law must now be made use of to evaluate $\frac{d\sigma}{d\theta}$.

The foregoing results, once it is stipulated which one of the multiple values of the several constants is to be understood by a given symbol, are perfectly applicable to heterogeneous and

Digitized by Google Original from HARVARD UNIVERSITY

anisotropic bodies; nor need the vibrations be small enough to be isochronous, provided the restriction to the same generalized shape is taken to include the deformations. But, now, for homogeneous, isotropic bodies

$$\sigma = \frac{1}{2}\frac{E}{\mu} - 1 \tag{3}$$

Differentiating (3), and substituting the result in (2), gives finally

$$\dot{n} = \tfrac{1}{2}\left[(c+1)\,\alpha - c\beta + \gamma\right]$$

in which

$$\left.\begin{aligned} c &= 2\,(1+\sigma)\,\frac{\Phi'}{\Phi} = (1+\sigma)\,\frac{d}{d\sigma}\log\left(\frac{mn^2}{LE}\right) \\ &= 2\,(1+\sigma)\,\frac{\Psi'}{\Psi} - 1 = (1+\sigma)\,\frac{d}{d\sigma}\log\left(\frac{mn^2}{L\mu}\right) - 1 \end{aligned}\right\} \tag{4}$$

The simplicity of equation (4) is noteworthy; it shows that, for bodies made of materials for which α, β, and γ are known, the effect of temperature on frequency can be determined empirically without altering the temperature of the models; and, therefore, without any restrictions on the thermal properties of the materials the models are made of. Note that in plotting $\frac{mn^2}{LE}$ or $\frac{mn^2}{L\mu}$ against σ to determine c as a function of σ graphically, relative values are sufficient; for the existence of an unknown constant numerical factor will not alter the slope of a logarithmic plot. The same remark applies below, wherever similar expressions occur.

From (4) the condition for temperature compensation is that

$$\frac{\beta}{\alpha} = 1 + \frac{1}{c}\left(1 + \frac{\gamma}{\alpha}\right) \tag{5}$$

When γ is small compared to α (for steel γ is about 1/25 of α), $\frac{\beta}{\alpha} = 1 + \frac{1}{c}$. The two methods of compensation suggested in the previous paper—altering the composition of the material, or altering the geometrical shape of the body—are equally applicable here.

Digitized by Google Original from HARVARD UNIVERSITY

Nothing that has been said prevents Φ in (1), and therefore c in (5), from being a multivalued function, corresponding to the existence of more than one mode of vibration. From this it might be imagined that the condition for compensation (5) would not apply to more than one mode of vibration at a time; so that, if an alloy were so chosen as to compensate the fundamental, the pitch of the harmonics would alter with temperature. Closer examination shows that, for any two frequencies which stand in a constant ratio $\frac{n_1}{n_2} = k$, where k is independent of Poisson's ratio, the values of c will be identical, and compensation will be possible simultaneously, if possible at all.

The relation of frequency to stiffness. From equation (3) of the previous paper, $S = LE\,\phi\,(\sigma) = L\mu\,\psi\,(\sigma)$. Comparing with (1) above,

$$n = \sqrt{\frac{S}{m}}\, f\,(\sigma) \tag{6}$$

in which the form of f will depend on the generalized shape.

In passing it may be noted that the corresponding expressions in terms of torsional stiffness are sometimes preferable. It can be shown that the torsional stiffness or rigidity

$$S_t = L^3E\ \phi_t\,(\sigma) = L^3\mu\,\psi_t\,(\sigma) \tag{7}$$

so that

$$n = \frac{1}{L}\sqrt{\frac{S_t}{m}}\, f_t(\sigma) \tag{8}$$

From (7), also,

$$\dot{S}_t = (C_t + 1)\,\alpha - C_t\beta + 3\,\gamma$$

in which

$$\left.\begin{aligned} C_t &= (1+\sigma)\frac{\phi_t'}{\phi} = (1+\sigma)\frac{d}{d\sigma}\log\left(\frac{S_t}{L^3E}\right) \\ &= (1+\sigma)\frac{\psi_t'}{\psi} - 1 = (1+\sigma)\frac{d}{d\sigma}\log\left(\frac{L^3\mu}{S_t}\right) - 1 \end{aligned}\right\} \tag{9}$$

The use of (7), for example, as a recipe for model experiments, would render unnecessary the St. Venant theory of the torsion of

Digitized by Google
Original from
HARVARD UNIVERSITY

prisms, so far as any practical application to the stiffness of beams or galvanometer suspensions is concerned.

Formulas for frequency of a coupled system. From (6),

$$n = \sqrt{\frac{S_1 + S_2}{m_1 + m_2}}\, f(\sigma) \tag{10}$$

because $m = m_1 + m_2$, and, for forces acting at the coupling, $S = S_1 + S_2$ (equation (11) of previous paper). Since f depends on the generalized shape, it will be different for different values of the ratio R, and in any case it is multivalued.

In the particular case of two bodies having the *same* generalized shape and σ, S_1 and S_2 of (10) can be replaced by their equivalents in terms of n_1 and n_2 by virtue of (6), with the result

$$n = \sqrt{R\, n_1^2 + (1 - R)\, n_2^2}\; F(R, \sigma) \tag{11}$$

The function F depends only on the generalized shape; not at all on the absolute sizes, masses, or elastic moduli of the bodies.

Formulas for change in frequency of coupled system with temperature. Differentiating (10) logarithmically gives, in the case of two bodies of different generalized shapes but of the *same material*,

$$\left.\begin{aligned} \dot{n} &= \tfrac{1}{2}\left[(K+1)\,\alpha - K\,\beta + \gamma\right] \\ \text{in which} \qquad K &= \eta C_1 + (1-\eta)\, C_2 + C_{12} \\ C_{12} &= 2\,(1+\sigma)\frac{f'}{f} = (1+\sigma)\frac{d}{d\sigma}\log\left(\frac{mn^2}{S}\right) \end{aligned}\right\} \tag{12}$$

and in which C_1 and C_2 are the appropriate values for the ordinary shape factor C for stiffness, as given in the previous paper; viz.,

$$\begin{aligned} C_1 &= (1+\sigma)\frac{\phi_1'}{\phi_1} = (1+\sigma)\frac{d}{d\sigma}\log\left(\frac{S_1}{L_1 E_1}\right) \\ &= (1+\sigma)\frac{\psi_1'}{\psi_1} - 1 = (1+\sigma)\frac{d}{d\sigma}\log\left(\frac{S_1}{L_1 \mu_1}\right) - 1, \end{aligned}$$

with a like expression for C_2.

Digitized by Google Original from HARVARD UNIVERSITY

For two bodies of the same material and, also, of the same generalized shape, differentiating (11) gives for K in (12) the more simple expression.

$$K = c + 2(1 + \sigma) \frac{F'}{F} \tag{13}$$

which does not require observations of stiffness.

In any event the term C_{12} vanishes when complex stresses are absent, for S will then be independent of Poisson's ratio, and f therefore a constant. But C_{12} is the only term in (12) which involves the masses of the bodies in any way. Hence the curious conclusion that, when complex stresses are absent, $\dot{n}$ will be independent of both the absolute mass and the mass distribution.

SOME EXAMPLES

1. *Waves in an infinite elastic plate.* The most recent work on this subject[2] affords an instance of equation (1); for while the result as published does not resemble equation (1), it reduces to it identically on setting $\Phi_0(\sigma) = \pi(2k+1)\sqrt{\frac{1-\sigma}{(1+\sigma)(1-2\sigma)}}$ in which k is any integer, the length L of equation (1) being taken to be the thickness of the plate.

2. *Resonance periods of similar structures.* Let quantities pertaining to the original, full-sized structure be distinguished by the subscript 0; while those referring to the model are without subscripts. Then by (1) and (6)

$$\frac{n_0}{n} = \frac{L}{L_0}\sqrt{\frac{E_0}{E}}\sqrt{\frac{\rho}{\rho_0}} = \sqrt{\frac{S_0}{S}}\sqrt{\frac{m}{m_0}}$$

the first form being preferable when stiffness measurements can not be made; the second when the properties of the material are not known.

3. *Temperature compensation of ordinary tuning fork.* For any case of pure bending or stretching, β can not enter (4); hence $c = 0$, and $\dot{n} = \frac{1}{2}(\alpha + \gamma)$, which agrees with (2). Assuming α negative and γ positive, as is true for steel, compensa-

[2] LAMB, H. Proc. Roy. Soc. **93** (A): 114–128, eq. (80). 1917.

Digitized by Google Original from HARVARD UNIVERSITY

tion requires that their numerical values be made equal. There were some persons who took the trouble to construct a certain tuning fork of invar, in hopes of diminishing its temperature coefficient; as would be seen from the above equation, this only made matters worse.

4. *Shrill tuning fork.* For any case of pure twisting or shearing, such as the very short stubby forks used for producing inaudible notes, α cannot enter (4); $c = -1$, and $\dot{n} = \frac{1}{2}(\beta + \gamma)$.

5. *Telephone diaphragm.* For the case of a thin flat circular disc clamped at the edge, and so approximating a telephone diaphragm, the expression for c which would be obtained from model experiments in accordance with (4), if it were not already available as a result of integration,[3] is $c = \frac{2\sigma}{1-\sigma}$. With $\sigma = 0.3$, c = about $\frac{6}{7}$, so that (4) becomes $\dot{n} = \frac{13}{14}\alpha - \frac{3}{7}\beta + \frac{1}{2}\gamma$. Complete compensation would require that β be about twice α. (Steel samples have been found, with $\frac{\beta}{\alpha}$ considerably greater and also less than 2.) But note from (4) that the α and β terms will enter with opposite signs whenever C is positive. Since C is positive for the disc shape, it appears that the temperature coefficient of a disc will always be small compared with that of a tuning fork of the same material, no matter what that material is.

6. *Spring with distributed mass.* If the mass is uniformly distributed in the direction of the displacement and remains so during the deformation, it may be shown by integration that $n = \sqrt{\frac{S}{m}}\left[\frac{1}{2\pi}\left(1 + \frac{1}{3}\frac{m_0}{m}\right)^{-\frac{1}{2}}\right]$. This expression is consistent with (6); $f(\sigma)$ being a constant depending on the ratio of the mass of the spring, m_0, to the attached mass, m.

[3] Rayleigh in his Theory of Sound, vol. I, § 221 a, gives for the disc a formula which, in present notation, may be written $n = \sqrt{\frac{LE}{m}}\left[0.833\left(\frac{h}{\ }\right)^{\frac{3}{2}}(1-\sigma^2)^{-\frac{1}{2}}\right]$. Here L is the diameter and h the thickness. Thus $\Phi(\sigma) = \text{const.}\,(1-\sigma^2)^{-\frac{1}{2}}$. Differentiating as directed by (4) gives the expression for c. (In footnote 6 of previous paper replace 32π by $\frac{32}{3}\pi$.)

Digitized by Google Original from HARVARD UNIVERSITY

7. *Balance wheel of a watch.* The well-known expression $n = \frac{1}{2\pi}\sqrt{\frac{S_t}{I}}$ for the case of a weightless spring acting on a rigid mass of moment of inertia I, may also be written $n = \frac{1}{r}\sqrt{\frac{S_t}{m}}\frac{1}{2\pi}$ in which r is the radius of gyration. This agrees with (8). Differentiating, $\dot{n} = \frac{1}{2}\dot{S}_t - \dot{r}$. For the hair spring (pure bending), (9) becomes $\dot{S}_t = \alpha + 3\gamma$, hence for the balance wheel $\dot{n} = \frac{1}{2}\alpha + \frac{3}{2}\gamma - \dot{r}$. The condition for compensation is therefore that the radius of gyration shall be constrained to vary with temperature at the rate $\dot{r} = \frac{1}{2}(\alpha + 3\gamma)$.

8. *Two springs coupled together.* Let spring 1, strained purely by twisting, be coupled to spring 2, which is strained purely by bending; and let both springs be made of the same material. Then ψ_1 and ϕ_2 are constants, so that $C_1 = -1$, $C_2 = 0$, $C_{12} = 0$; $\therefore K = -\eta$, and (12) becomes $\dot{n} = \frac{1}{2}[(1-\eta)\alpha + \eta\beta + \gamma]$. When the twisted spring is stiffer than the bent spring, the β term predominates, and vice-versa. For springs equally stiff, $\eta = \frac{1}{2}$, $\therefore \dot{n} = \frac{\alpha}{4} + \frac{\beta}{4} + \frac{\gamma}{2}$. For two helical springs, $C_1 = C_2 = -1$, so that $\dot{n} = \frac{1}{2}(\beta + \gamma)$; for two leaf springs or elliptical springs, $C_1 = C_2 = 0$, so that $\dot{n} = \frac{1}{2}(\alpha + \gamma)$. These results, including the above formula for $\dot{n}$ in terms of α, β, γ, and η, and subject to the limitations stated, are true independently of the shapes and mass distributions of the two bodies, as well as of their absolute sizes, masses, and elastic moduli.

CRYSTAL OPTICS.—*Dispersion and other optical properties of carborundum.* H. E. MERWIN, Geophysical Laboratory.

Along the edge of a very pale green carborundum crystal two areas, each about 0.5 mm. square, were found which were suitable for measuring the ordinary refractive index. The angles, measured from the base, were 32° 13′ and 34° 15′. The refractive index for the extraordinary ray was found by measurements on the interference figure[1] of a colorless plate 0.675 mm. thick and about 3 mm. square.

[1] See BAUER, M. Neues Jahrb., **2**: 49. 1882–83; also Journ. Wash. Acad. Sci., **4**: 533 and 538. 1914.

Digitized by Google Original from HARVARD UNIVERSITY

The dispersion and birefringence are both much less than those calculated by L. E. Jewell[2] from interference phenomena. The birefringence corresponds closely to Becke's[3] measurement, but the refractive index, ω_{Na}, is less than his rough measurements indicated.

TABLE 1

INDICES OF REFRACTION OF CARBONRUNDUM

λ	ω	ε
μμ		
755	2.616	2.654
745	2.618	2.656
726	2.622	2.660
700	2.627	2.666
671	2.633	2.673
589	2.654	2.697
535	2.675	2.721
486	2.700	2.749
468	2.713	2.763
434	2.741	2.794
422	2.753	2.808
416	2.757	2.812

Microscopical study of several samples of granular carborundum has revealed no definite variations in the refractive index for red light, even in grains of different color. Coarse material which is very black may be, when powdered—grains a few hundredths of a millimeter in diameter—fairly transparent. Bluish grains are notably pleochroic, some from light blue to dark blue, some from olive green to greenish blue. The ω is the more strongly absorbed. Coarse black crystals intimately associated with graphite appear to contain small amounts of material which give small grains a grayish to bluish color by transmitted light, but this material, in all the grains so far observed, has been submicroscopic in size.

The results for ω in table 1 were obtained as averages from the two prisms. The observed values for one prism were 0.003–0.005 higher than for the other. But inasmuch as one face of

[2] Quoted by TONE, in Mineral Industry, **16**: 153. 1907.
[3] Zeitschr. Kryst., **24**: 524. 1895.

Digitized by Google Original from HARVARD UNIVERSITY

each prism showed curvature of 5′ the differences should be regarded as observational. The difference[4] $\epsilon-\omega$ is probably not in error more than ± 0.001.

A recent notice of a study of the physical properties of carborundum by O. Weigel has been published,[5] but no details are available.

MINERALOGY.—*The nomenclature and classification of the native element minerals.* Edgar T. Wherry,[1] National Museum.

In many respects it would be difficult to improve upon the nomenclature and classification of native elements worked out in Dana's System of Mineralogy, yet with the advance of scientific knowledge new points of view are certain to arise and newly discovered species to demand place in any scheme, so that changes must be introduced. A few suggestions in this direction are here put forward, for discussion, criticism, or whatever fate they may seem to readers to deserve.

NOMENCLATURE

The names adopted by Dana are as a rule satisfactory, but wherever considerations of simplicity, consistency, and clearness suggest the desirability of changes from his usage, there should be no hesitation about introducing others.

When an element is known to occur in nature in but one form, no name different from that used for it in chemistry is needed; but several elements show polymorphous forms, and these have heretofore been distinguished by adding either: a suffix, as in sulfur and sulfur*ite;* a prefix, as in palladium and *allo*palladium; Greek letters as prefixes, as in α-sulfur and β-sulfur; or adjectives, as in *yellow* phosphorus and *monoclinic* selenium. The last method, using crystallographic adjectives, is preferable, because it can be employed alike in all cases, and its systematic introduction into mineralogical nomenclature is therefore recommended.

[4] The value for the D-line was checked on a thinner plate and, roughly for lithium light, on grains in immersion liquids.

[5] Weigel, O. Chem. Abstr., **11**: 1066. 1917.

[1] Transferred August 16th to the Bureau of Chemistry.

Digitized by Google

Original from HARVARD UNIVERSITY

Many minerals consist of isomorphous mixtures of two or more elements. Two different methods of deriving names for these have been used in the past: first, by combining the names of the elements present, as selentellurium for selenium-bearing tellurium, platiniridium for platinum-bearing iridium, and nickeliron for nickel-bearing iron; and second, by introducing arbitrary or special terms, as volcanite for selenium-bearing sulfur, sisserskite for iridium-bearing osmium, and porpezite for palladium-bearing gold. As one element is almost invariably greatly in excess over the others, these should be regarded as varieties, rather than elevated to the rank of species. It is, further, believed to be highly desirable that species and varieties be distinguished by the terminology applied to them. As arbitrary or special names, including in this case the names of chemical elements, are generally accepted as appropriate for species, it is thought that their application to varieties should be discouraged, and such names as volcanite, sisserskite, and porpezite be discarded.

The use of chemical prefixes with species names in general is also objectionable because of the resulting inconsistencies and ambiguities, as emphasized by Prof. A. F. Rogers;[2] to this the native elements are no exception. For example, the mineral termed allemontite by Haidinger in 1845, a variety of arsenic containing a small amount of isomorphous antimony, has been called antimonarsenic by some mineralogists, and arsenantimony by others. When two diametrically opposed terms are thus applied to a single substance, it is evident that neither can be regarded as clearly expressing its nature, or accepted to the exclusion of others. Many other minerals, as amalgam, iridosmine, awaruite, etc., show similar confusion in their nomenclature.

To simplify matters and to make the terms as unambiguous as possible, the plan recommended by Professor Rogers in the paper cited is favored: that all varieties due to isomorphism be named by means of adjectives, formed by adding the suffix *iferous* to the names of the elements present in smaller amounts (the names being put in the Latin form when necessary for euphony).

[2] Proc. Am. Phil. Soc., **52**: 610. 1913.

Digitized by Google Original from HARVARD UNIVERSITY

CLASSIFICATION

In Dana's System the native elements are first split up into three divisions, non-metals, semi-metals, and metals. The first two divisions, however, show no pronounced differences, and various inconsistencies arise in apportioning the elements between them. For instance, graphite, which is classed as a non-metal, has a more metallic luster and is a better conductor of electricity than arsenic, which is classed as a semi-metal. Selenium is regarded as a non-metal when monoclinic, and as a semi-metal when rhombohedral; and the same would have to be done with sulfur, arsenic, and antimony, were all of their forms included, for these three crystallize in one or more forms with so-called non-metallic, and others with so-called semi-metallic properties. But the illogical character of this arrangement, which assumes that the element changes its fundamental nature on appearing in an unusual crystallized condition, is evident. The distinction between the non- and semi-metals appears, then, to be rather artificial, and both convenience and accuracy suggest that it be abandoned.

The major divisions are in turn subdivided into groups. Throughout the greater part of Dana's System, the groups are composed of minerals of close chemical and crystallographic relationships. Among the elements, however, this arrangement is to some extent departed from, resulting in the establishment of a "carbon group," in which crystallographic similarity is lacking, and a "platinum group," which includes two types of crystallization. As no good reason for this departure appears to exist, it is recommended that these groups be placed on a crystallographic basis. The carbon group then yields an isometric diamond group, into which several recently discovered non-metallic elements fall, and a hexagonal-trigonal graphite group, which may for simplicity be united with the crystallographically identical arsenic group; in graphite $c = 1.386$, which lies between the value for arsenic, 1.401, and that for antimony, 1.324; all three elements have basal cleavage.

Similarly, the platinum group may be split into an isometric and a hexagonal-trigonal group, while tin, which crystallizes in

Digitized by Google Original from HARVARD UNIVERSITY

a still different system, the tetragonal, is assigned to a group by itself.

In listing groups it is thought best to give those of the highest crystallographic symmetry first place, and to arrange the others in the order of decrease in symmetry.

A table of native elements based on the above recommendations follows. Its criticism by anyone interested in the systematic arrangement of mineralogic data will be welcomed.

NOTES ON THE TABLE

The first column includes the names of the species and varieties worked out according to the principles above outlined and recommended for adoption. The composition of each species and variety is given in the second column, isomorphous replacement being represented by a comma, and the element present in largest amount in each case being placed first.

Column 3 contains reasons for the names or arrangements adopted, synonyms (in quotations), and references for the minerals not listed by Dana in either the System of Mineralogy (1892) or the three Appendixes (1899, 1909, 1915).

NATIVE ELEMENT MINERALS. The chemical elements occurring in nature in the free state.

NON-METALS (INCLUDING "SEMI-METALS")		Combined for simplicity.
DIAMOND GROUP. ISOMETRIC		New; includes all non-metals and semi-metals with isometric crystallization, arranged in order of the periodic system.
Diamond (isometric carbon)	C	The retention of the arbitrary name diamond is an exception to the rule for naming polymorphs, but is justified by usage.
Massive	C	"Bort."
Black massive	C	"Carbonado."
Phosphorus, isometric	P	"Yellow phosphorus," "β-phosphorus." Meteoritic; very doubtful.
Arsenic, isometric	As	"Yellow arsenic." Occurrence in nature reported by Vernadskii, *Opuit Opisatel'noi Mineralogii* (Descriptive Mineralogy) **1**, 1908; *Centr. Min. Geol.*, **1912**: 762. (Not in Dana.)
Tantalum, columbiferous	Ta, Cb	

Digitized by Google Original from HARVARD UNIVERSITY

GRAPHITE GROUP. HEXAGONAL-TRIGONAL....................	New; a combination of graphite with Dana's tellurium-arsenic group, arranged in order of the periodic system.
Graphite (trigonal carbon)...C	Name retained for the same reason as that of diamond; "Cliftonite" is a meteoritic paramorph of graphite after diamond.
Arsenic, trigonal............As	
Antimoniferous.........As, Sb	"Allemontite" (Dana No. 9). Classed as a species by Dana, but there is no evidence that it is anything but a variety of arsenic containing a variable amount of isomorphous antimony.
Antimony...................Sb	
Arseniferous............Sb, As	
Bismuth....................Bi	
Tellurium, trigonal..........Te	
Seleniferous............Te, Se	"Selentellurium" (Dana No. 6). Classed as a species by Dana, but there is no evidence that it is anything but a variety of tellurium containing a variable amount of isomorphous selenium. This selenium is present in a trigonal form, which has not yet been discovered to exist independently in nature, but has been produced artificially.
ORTHORHOMBIC-SULFUR GROUP..	The "Sulphur group" of Dana.
Sulfur, orthorhombic........S	The spelling of this name with *f* instead of *ph* is justified by history and usage and has been adopted by the American Chemical Society.
Seleniferous.............S, Se	"Selensulphur" (Dana No. 4), "volcanite." Classed as a species by Dana, but there is no definite evidence that it is anything but a variety of sulfur containing a variable amount of isomorphous selenium; this selenium is present in an orthorhombic form as yet unknown independently.
Telluriferous............S, Te	"Tellursulphur"
MONOCLINIC-SULFUR GROUP......	New; includes all non-metals and semimetals with monoclinic crystallization.
Sulfur, monoclinic..........S	"β-sulfur," "γ-sulfur." β-sulfur is common around volcanoes, but is preservable only as a paramorph of orthorhombic sulfur; γ-sulfur has been reported to occur in nature by Vernadskii, *Opuit*

Digitized by Google

Original from HARVARD UNIVERSITY

	Opisatel'noi Mineralogii, **1**, 1908; *Centr. Min. Geol.*, **1912**: 761; and still another form in stable crystals has been described by Suzuki, *Beitr. Min. Japan*, **5**: 231. 1915. (Not in Dana.)
Selenium, monoclinic........**Se**	"α-selenium"
Arsenic, monoclinic.........**As**	"Arsenolamprite." Crystallization not certain.
COLLOIDAL GROUP. AMORPHOUS.	New; includes all non-metals and semimetals occurring in the amorphous state.
Carbon, amorphous..........**C**	The coloring matter of black sediments.
Silicon, dispersoidal.........**Si**	Suggested to be the cause of the color of smoky quartz, though without statement of evidence, by Königsberger and Müller, *Centr. Min. Geol.*, **1906**: 73, note. (Not in Dana.)
Phosphorus, amorphous.....**P**	Occurrence in nature reported by Vernadskii, *Opuit Opisatel'noi Mineralogii*, **1**, 1908; *Centr. Min. Geol.*, **1912**: 762. (Not in Dana.)
Sulfur, amorphous..........**S**	"Sulfurite." A precipitate in sulfur-spring water; also a volcanic product. (Not in Dana.)
Selenium, amorphous........**Se**	Occurrence in nature pointed out by Zambonini, *Mineralogia Vesuviana*, p. 24, 1910. (Not in Dana.)
Iodine, amorphous..........**I**	Occurrence in nature reported by Skey in 1877; Vernadskii, *Centr. Min. Geol.*, **1912**: 762. (Not in Dana.)
METALS........................	Includes the native elements of predominantly basic character.
COPPER GROUP. ISOMETRIC....	When the minerals of Dana's "gold group" are arranged according to the periodic system, copper comes first and the group is here named after it.
Copper......................**Cu**	Wire copper, a variety, is probably a paramorph of crystalline copper after amorphous copper which has been forced through small openings while soft, corresponding to wire silver. (See below.)
Argentiferous...........**Cu, Ag**	
Mercuriferous...........**Cu, Hg**	Brush, *Am. Journ. Sci.*, [2], **31**: 354. 1861, throws doubt on the occurrence of this variety.

Digitized by Google
Original from HARVARD UNIVERSITY

Ferriferous	**Cu, Fe**	
Silver	**Ag**	Wire silver, a common variety, is a paramorph of crystalline silver after amorphous silver, which has been forced through small openings while soft. Mügge, *Neues Jahrb. Min. Geol.*, **1913** (II): 1.
Cupriferous	**Ag, Cu**	
Auriferous	**Ag, Au**	"Küstelite"
Mercuriferous	**Ag, Hg**	"Amalgam," in part; "arquerite," "bordosite," "kongsbergite;" included, along with argentiferous mercury, in the species "amalgam" by Dana, but there is no definite evidence that it is anything but a variety of silver containing variable amounts of isomorphous mercury.
Gold	**Au**	Wire gold, a variety, is probably a paramorph of crystalline gold after amorphous gold which has been forced through small openings while soft, corresponding to wire silver. (See above.)
Cupriferous	**Au, Cu**	
Argentiferous	**Au, Ag**	"Electrum." Given a special name by the ancients, though recognized by them to be only an argentiferous variety of gold.
Mercuriferous	**Au, Hg**	Occurrence in nature reported by Schmitz, *Z. deut. geol. Ges.*, **4**: 137. 1852. (Not in Dana.)
Rhodiferous	**Au, Rh**	"Rhodite."
Palladiferous	**Au, Pd**	"Porpezite."
Iridiferous	**Au, Ir**	Occurrence in nature reported by Wöhler, 1834; Vernadskii, *Centr. Min. Geol.*, **1912**, 760; confirmed by Chernik, *Trav. Mus. Acad. Sci. Petrograd*, **6**: 49. 1912. (Not in Dana.)
Platiniferous	**Au, Pt**	Occurrence in nature discovered by Chernik, *Trav. Mus. Acad. Sci. Petrograd*, **6**: 49. 1912. (Not in Dana.)
Mercury	**Hg**	"Quicksilver." Liquid at ordinary temperatures, but crystallizes at −39°C.
Argentiferous	**Hg, Ag**	"Amalgam" in part. Included, along with mercuriferous silver, in the species "amalgam" by Dana, but there is no definite evidence that it is anything but a variety of mercury containing variable amounts of silver, either in solid, isomorphous form, or dissolved, liquid form.

Digitized by Google

Original from
HARVARD UNIVERSITY

Auriferous..............**Hg, Au**	"Gold-amalgam" in part. The gold is either in solid, isomorphous form, or dissolved, liquid form.
Lead........................**Pb**	
IRON GROUP. ISOMETRIC......	When the minerals of Dana's "platinum-iron group" are arranged according to the periodic system, iron comes first, and the group is here named after it.
Iron.............................**Fe**	"Ferrite." Native iron, both meteoritic and terrestrial, may contain isomorphous copper, vanadium, chromium, manganese, cobalt, nickel, ruthenium, palladium, iridium, platinum, and perhaps other metals; but only two of these occur in sufficient amount to be regarded as giving rise to definite varieties.
Nickeliferous............**Fe, Ni**	"Edmonsonite," "kamacite,""lamprite," "plessite," "taenite." Meteoritic; the varieties are chiefly separated on the basis of structure.
Platiniferous............**Fe, Pt**	Occurrence in nature reported by Osann, *Ann. Phys. Chem.*, **14**: 329. 1827. (Not in Dana.)
Nickel, ferriferous...........**Ni, Fe**	"Awaruite," "josephinite," "octibbehite," "souesite." Both meteoritic and terrestrial; the minerals referred to by the synonyms have been regarded as separate species, but there is no definite evidence that they are anything but varieties of nickel containing small, variable, amounts of isomorphous iron.
Palladium, platiniferous.....**Pd, Pt**	"Native palladium." May also contain small amounts of isomorphous iridium.
Iridium, platiniferous.......**Ir, Pt**	"Native iridium." Named "iridium" by Dana and others, although analyses cited show the presence of at least 19% of isomorphous platinum and smaller amounts of other metals, especialy copper and palladium; pure iridium is not known to occur in nature.
Platinum, ferriferous........**Pt, Fe**	"Native platinum." Named platinum by Dana and others, although analyses show the presence of considerable amounts of isomorphous copper, gold, iron, nickel, rhodium, palladium, osmium, and iridium; only two of

Digitized by Google Original from HARVARD UNIVERSITY

	these, iron and iridium, occur in sufficient amount to be regarded as giving rise to definite varieties.
Iridiferous..............Pt, Ir	Included by Dana partly under "iridium" and partly under "platinum."
TRIGONAL-PALLADIUM GROUP.....	New; includes zinc, classed by Dana as a semi-metal, and the trigonal minerals of the platinum-iron group.
Zinc.......................Zn	Occurrence in nature doubtful.
Palladium, trigonal..........Pd	"Allopalladium." May contain isomorphous silver, gold, and platinum, although none of these occur in sufficient amounts to be regarded as giving rise to definite varieties.
Osmium, iridiferous.........Os, Ir	"Dark iridosmine," "sisserskite." Included, along with the following mineral, in the species "iridosmine" by Dana; but there is no definite evidence that it is anything but a variety of trigonal osmium containing variable amounts of iridium and perhaps other metals.
Iridium, osmiferous.........Ir, Os	"Light iridosmine," "nevyanskite." Included, along with the preceding variety, in the species "iridosmine" by Dana; but there is no definite evidence that it is anything but a variety of trigonal iridium; may contain isomorphous copper, iron, ruthenium, rhodium, palladium, osmium, and platinum; of these only osmium occurs in sufficient amount to be regarded as giving rise to a definite variety.
TIN GROUP. TETRAGONAL........	New; included by Dana in the gold group but here separated on the basis of different crystallization.
Tin.........................Sn	Occurrence in nature never proved beyond doubt, although there is a specimen in the U. S. National Museum from placers in California which has every appearance of being a natural product.
COLLOIDAL GROUP. AMORPHOUS	New; includes all metals occurring in the amorphous state.
Silver, amorphous...........Ag	Known to early German miners, but its character was first recognized by Cornu, *Z. Chem. Ind. Kolloide*, **4**: 187. 1909. (Not in Dana.)

Digitized by Google

Original from
HARVARD UNIVERSITY

Gold, amorphous............Au	Occurrence in nature reported by Cornu, *Z. Chem. Ind. Kolloide*, **4**: 187. 1909. (Not in Dana.)
Sodium, dispersoidal.......Na	First suggested by Elster and Geitel to be the cause of color of blue halite, *Ann. Phys. Chem.*, **62**: 559. 1897; this has been confirmed by ultramicroscopic study and by successful synthetic experiments, as shown especially by Goldstein, *Nature*, **94**: 494. 1914. (Not in Dana.)
Potassium, dispersoidal......K	Suggested to be the cause of color of blue sylvite, by analogy with the preceding substance, by Cornu, *Centr. Min. Geol.*, **1907**, 168; this has been confirmed as in the preceding instance. (Not in Dana.)
Calcium, dispersoidal........Ca	Suggested to be the cause of color of certain fluorites by Doelter, *Sitzungsb. Akad. Wiss. Wien*, **1906**, 1312. (Not in Dana.)

MINERALOGY.—*The crystal form of spencerite.* T. L. WALKER, Royal Ontario Museum of Mineralogy, Toronto.

The new mineral spencerite—$Zn_3(PO_4)_2 . Zn(OH)_2 . 3H_2O$—was described by the author in 1916.[1] The material then available was obtained from the H. B. mine near Salmo, British Columbia. It is remarkable for its purity but is wholly in the massive form. From an optical examination it was found to be monoclinic and polysynthetically twinned, the twinning plane and composition face being the orthopinacoid. Plates parallel to the best cleavage, accepted as the orthopinacoid, showed an interference figure with the acute bisectrix nearly normal to this cleavage. Such plates when etched yielded etch figures symmetrical about only one plane. From these observations the author concluded that the mineral is monoclinic.

Spencerite occurs along with other oxidized zinc ores, forming the cores of stalactitic growths, the outer zone of which is always calamine. The spencerite being relatively soluble, the periphery of the spencerite core has as a rule been dissolved, leaving a space between the more soluble core and the resistant calamine.

[1] Mineralog. Mag., **18**, p. 76.

Digitized by Google Original from HARVARD UNIVERSITY

Under the circumstances the survival of crystals of the phosphate was hardly to be expected.

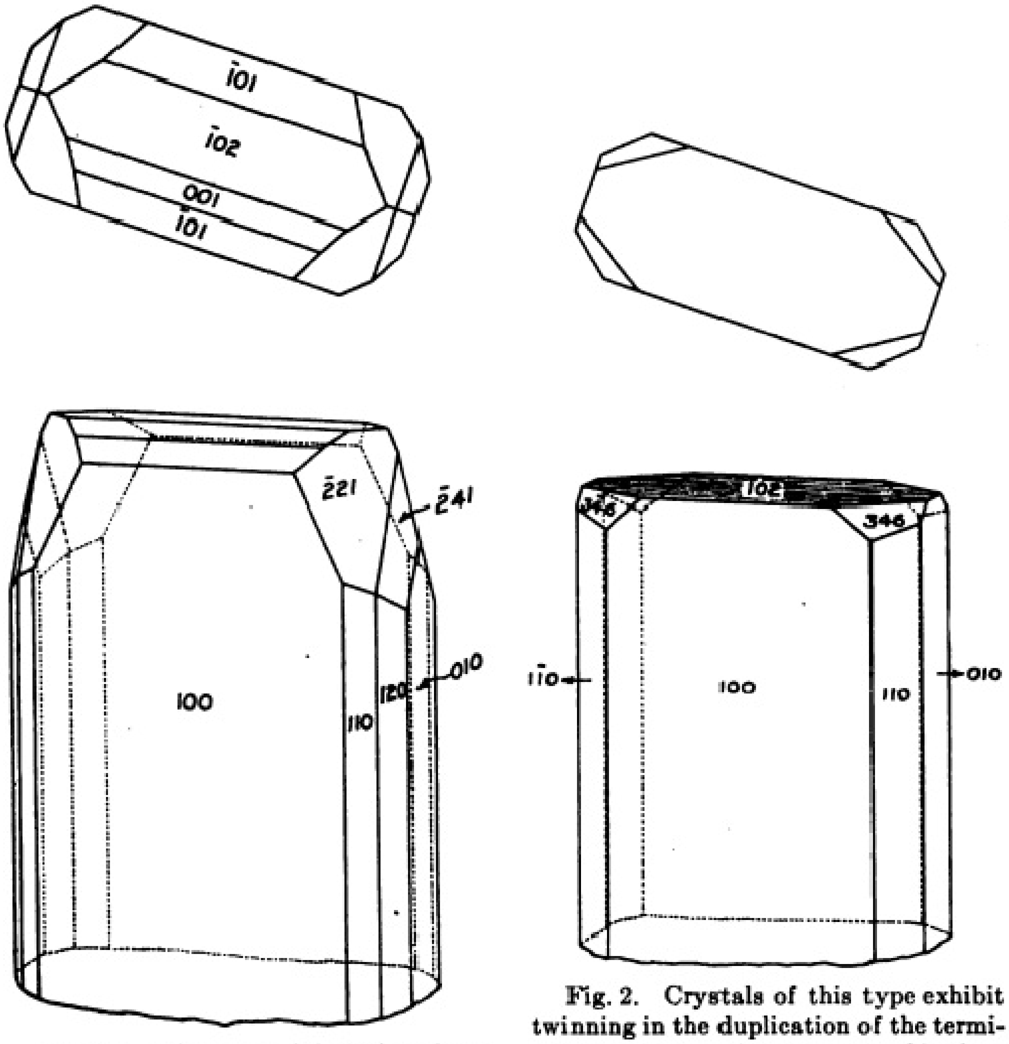


Fig. 1. The crystal is twinned on (100) and as a result of the twinning the forms ($\bar{2}41$) and ($\bar{2}21$) are each represented by four faces, thus giving the crystals a rhombic appearance.

Fig. 2. Crystals of this type exhibit twinning in the duplication of the terminal faces, (346) being represented by four faces while the two faces of ($\bar{1}02$) occur as striations on a large plane nearly coinciding in direction with a rhombic basal pinacoid.

Some specimens of this mineral recently obtained from the original locality contain small druses lined with sharp crystals of spencerite, the preservation of the crystals being apparently due to the cavities having been completely sealed up by calamine.

Digitized by Google Original from HARVARD UNIVERSITY

The crystals are very small, few exceeding 2 or 3 mm. in length. They are tabular in habit and in color, luster, and habit closely resemble small, bright crystals of calamine. The crystals, though small, are admirably suited for accurate measurements. The conclusions regarding the crystal form contained in the original contribution are confirmed, since the mineral is

TABLE 1

FORM	NUMBER OF MEASUREMENTS	ϕ		ρ	
		Measured	Calculated	Measured	Calculated
120	12	29° 34′	29° 32′	90°	90°
230	2	35° 50′	37° 04′	90°	90°
110	11	48° 32′	48° 34′	90°	90°
520	6	71° 07′	70° 34′	90°	90°
010	6	0	0	90°	90°
100	6	90°	90°	90°	90°
001	4	89° 56′	90°	26° 52′	26° 47′
$\bar{1}04$	2	90°	90°	11° 20′	11° 30′
$\bar{1}02$	3	90°	90°	5° 17′	5° 36′
304	1	89° 57′	90°	21° 07′	21° 47′
$\bar{1}01$	3	89° 53′	90°	34° 55′	35° 02′
$\bar{2}01$	1	89° 14′	90°	61° 30′	62° 20′
023	1	35° 40′	35° 26′	40° 57′	41° 03′
021	4	13° 30′	13° 21′	65° 32′	65° 25′
121	5	38° 36′	38° 48′	69° 53′	69° 53′
346	3	56° 58′	57° 22′	53° 05′	52° 46′
$\bar{1}11$	2	32° 55′	33° 23′	51° 49′	51° 53′
$\bar{1}21$	6	18° 06′	18° 14′	65° 48′	65° 57′
$\bar{2}21$	4	41° 52′	41° 52′	70° 41′	70° 43′
241	4	24° 23′	24° 08′	77° 53′	77° 54′

found to be monoclinic, with polysynthetic twinning on the pinacoid (100).

There are two types of crystals, the first of which is represented in figure 1. The peculiarity of this type is the prominence of the pyramid $\bar{2}21$ with relatively small terminal faces of the orthodiagonal zone. Crystals of the second type are terminated by

Digitized by Google Original from HARVARD UNIVERSITY

what appears to be a large face intersecting the prism edges at 90°. A careful examination shows that this large terminal plane is striated, the faces of the striations belonging to the form ($\bar{1}02$). (See fig. 2.) All the crystals measured are twinned and show faces of the two constituent individuals.

The polar elements derived from the measurements are as follows:

$$p_o = 1.0512; q_o = 0.9501; e = 0.45071; \mu = 63°13'$$

corresponding to the axial ratios,

$$a: b: c :: 1.0125: 1: 1.0643; \beta = 63°13'.$$

In table 1 are indicated the forms observed and the polar angles ϕ and ρ measured and calculated for the elements indicated above. The number of faces observed for each form on the four crystals measured is shown in the second column.

ETHNOLOGY.—*A prehistoric stone mortar from southern Arizona.*[1] J. WALTER FEWKES, Bureau of American Ethnology.

Prehistoric buildings in the Gila Valley differ from those of southern Colorado and New Mexico in materials employed, form, and details in construction and arrangement of sacred and other rooms. There are less pronounced differences in ceramics, implements, and household utensils of the two areas. The acquisition of a fine, characteristic stone mortar from near Casa Grande has led me to describe it and incidentally to refer to a feature in this object not shared with mortars from the true Pueblo area.

A short time ago I obtained from Mr. John Miller, one of my workmen at the Casa Grande ruin in 1907, a stone mortar of more than ordinary interest on account of its artistic character. This object was found 5 miles south of the Picacho reservoir, Arizona, where there are traces of ancient settlements. It is made of a light-colored volcanic stone of circular shape and has a flat base with a cavity or depression on the opposite face. The

[1] Published by permission of the Secretary of the Smithsonian Institution.

Digitized by Google Original from HARVARD UNIVERSITY

remarkable feature is a rattlesnake sculptured in high relief on the margin (fig. 1).

The body of this animal almost completely surrounds the mortar, the anterior end of the body being coiled, and the tail ending in four rattles and a button. The head projects from the coiled part of the body and is flat above, indented with three pits, two of which were intended for eyes. The body is covered with a cross hatching of incised lines representing scales, and the mouth is a horizontal slit. From the top of the nose to the opposite rim the diameter measures 4¼ inches and the depth of the cavity three-fourths of an inch.

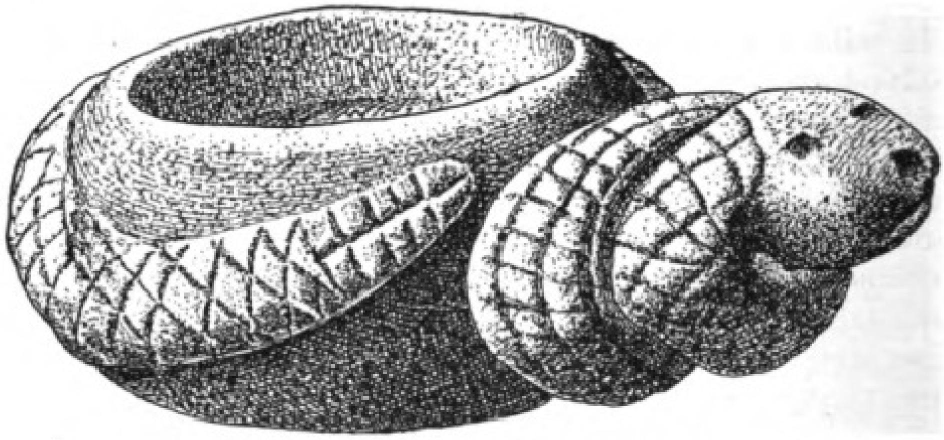


Fig. 1. Snake mortar. Diameter 4½ inches.

The above specimen is now in the Museum of the American Indian, Heye Foundation, New York City.

Mortars made of stone carved in animal forms are not rare in the Gila Valley, although outside of this area they are, so far as known, rarely found in numbers. There are many known examples of mortars of round, oblong shapes, sometimes with prolongations on the larger axes, representing conventionalized organs, but in others the intended form is so realistic that the animal can be roughly identified.

One of the best of these was found in Compound B of the Casa Grande group and figured as an idol in my report[2] on that ruin.

[2] Twenty-eighth Annual Report of the Bureau of American Ethnology, plate 47.

Digitized by Google

Original from HARVARD UNIVERSITY

Others in form of frogs and turtles may be seen in local collections or figured in descriptions of Gila Valley antiquities. I recall two mortars with serpentine bodies cut on their margins, neither of which is as well made as the specimen above described. Mortars from this region in the form of other animals are also known. A mortar from the San Pedro Valley resembling a horned quadruped is figured in my paper on Prehistoric Ruins of the Gila Valley,[3] and there is in the Museum of the University of Arizona a specimen similar to the last mentioned. Mr. Warren K. Moorehead[4] figures a mortar resembling a turtle or some reptile. In all these the depression or cavity of the mortar is situated on the back of the animal, whereas in the snake mortars, the snake surrounds or embraces the mortar.

It will be noticed that these specimens have a depression or cavity which has led to their identification as mortars. In this respect they differ from paint palettes, likewise prehistoric, found in numbers in the Gila region. The stones upon which paint is ordinarily ground among the Pueblos are flat, undecorated slabs, without cavities, or generally only shallow depressions. Similar palettes from the Gila are made with more care and their margins are commonly bands decorated with incised geometrical designs or even, in one or two known instances, with figures of snakes or other animals. They are ordinarily rectangular in form, but other shapes also occur, such as circles and ovals. A figure of one of these tablets or palettes in the shape of a bird was obtained from Pueblo Viejo on the Upper Gila, and published in my account of Two Summers' Work in Pueblo Ruins.[5] A typical hitherto undescribed rectangular paint palette which was plowed up by a farmer on the north side of the Gila, 6 miles from Florence, Arizona, is shown herewith (fig. 2). This is a thin slab of rock with a marginal frame covered with incised crosshatched lines recalling the conventional way of representing scales of a snake. This specimen, like the snake mortar, is

[3] Smithsonian Miscellaneous Collections, Quarterly Review, **5**, fig. 75*a*.

[4] The Stone Age in North America, **2**, fig. 416.

[5] Twenty-second Annual Report of the Bureau of American Ethnology; also Preliminary Report in Smithsonian Miscellaneous Collections, 1896.

Digitized by Google Original from HARVARD UNIVERSITY

also in the Museum of the American Indian, Heye Foundation. Similar paint palettes with modifications in decorations are widely distributed; those from the mound-builders sometimes bear incised figures of serpents in their surfaces. As a paint palette admits of few variations in form it is not strange that similar shapes occur likewise among Pueblos and mound-builders,[6] and, especially in predynastic times, in Egypt[7] (fig. 3).

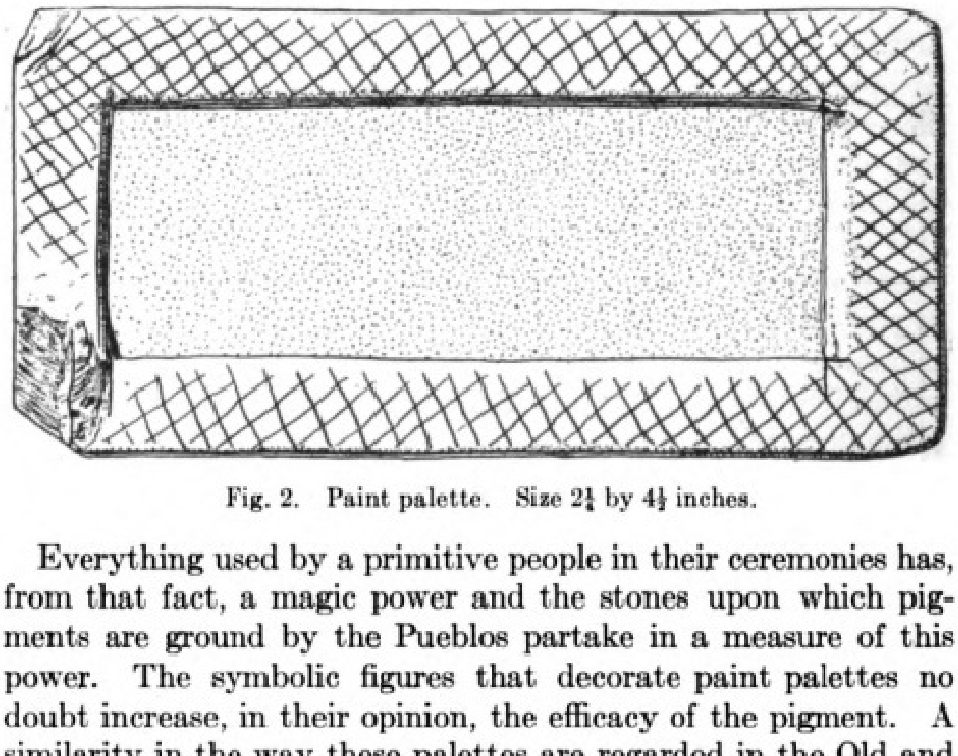


Fig. 2. Paint palette. Size 2¼ by 4½ inches.

Everything used by a primitive people in their ceremonies has, from that fact, a magic power and the stones upon which pigments are ground by the Pueblos partake in a measure of this power. The symbolic figures that decorate paint palettes no doubt increase, in their opinion, the efficacy of the pigment. A similarity in the way these palettes are regarded in the Old and the New World is a good instance of thought convergence.

A few objects of stone supposed to be pestles or paint grinders, possibly used with these pigment palettes, are known from the Gila. One of these from Casa Grande has the form of a "coiled serpent,"[8] a highly suggestive fact taken in connection with a snake-decorated mortar.

[6] Holmes, W. H., *Certain notched or scalloped stone tablets of the mound builders.* Amer. Anthropol., **8**, No. 1, fig. 9. Jan.–March, 1906.

[7] Bates, Oric. *Ancient Egyptian fishing.* Harvard African Studies, No. 1.

[8] Twenty-eighth Annual Report of the Bureau of American Ethnology, pl. 48, fig. 1.

Digitized by Google

Original from
HARVARD UNIVERSITY

The custom of decorating mortars and paint grinders with animal figures points to Mexican rather than Pueblo customs and kinship. The serpent as an element in sculpture is especially Mexican, although figures of the rattlesnake occur on pipes and stone or shell objects throughout the mound-builders and Pueblo areas; while painting of the same on pottery, and as pictographs ascribed to prehistoric times, are no less frequent. The cult of the Plumed Snake or, as some prefer to call it, the Horned Snake, occurs so constantly in Indian mythology and ritual that this

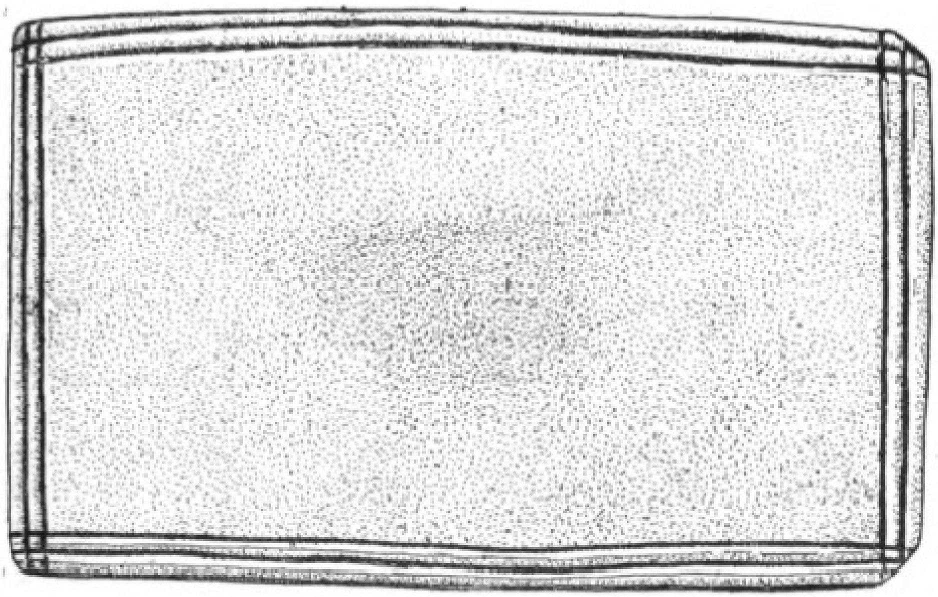


Fig. 3. Egyptian slate palette. Size 3¼ by 5¼ inches.

being is frequently represented on ceremonial paraphernalia; but there are, so far as I know, few if any mortars of prehistoric Indians of North America with sculptured figures that artistically excel the snake mortar above figured. The snake-entwined mortar is another evidence that the prehistoric culture of the Gila had a close relationship to that of the aborigines of northern Mexico.

Digitized by Google Original from HARVARD UNIVERSITY

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

TECHNOLOGY.—*Temperature measurements in Bessemer and open hearth practice.* GEORGE K. BURGESS. Bureau of Standards Technologic Paper No. 91. Pp. 29. 1917.

The problem of temperature measurement and pyrometric control of furnace casting and ingot teeming temperatures is shown, by a series of observations taken in several steel plants, to present no serious difficulties or uncertainties.

For this purpose the most satisfactory type of instrument is one of the optical pyrometers using monochromatic light and permitting observation of streams of metal from a distance.

It is shown that the necessary corrections to the observed optical pyrometer readings for emissivity of metal and oxides to give true temperatures, are sufficiently well known, but there may be uncertainty in the case of liquid slags.

For streams of liquid iron or steel the most probable value of emissivity to take, with a pyrometer using red light of wave length $\lambda = 0.65\ \mu$, is $e = 0.40$, corresponding to a correction of 139° for an observed temperature of 1500°C. The value of e for liquid slags is usually about 0.65 but varies with the composition of the slag. A table of emissivity corrections is included in the text.

It is believed that a continuous, systematic following of the temperature by the methods outlined in the paper would show the possibility of improvements, and give a greater certainty of the production of the desired quality of product. G. K. B.

Digitized by Google Original from HARVARD UNIVERSITY

REFERENCES

Under this heading it is proposed to include, by author, title, and citation, references to scientific papers published in or emanating from Washington. It is requested that authors cooperate with the editors by submitting titles promptly, following the style used below. These references are not intended to replace the more extended abstracts published elsewhere in this JOURNAL.

ASTROPHYSICS

ABBOTT, C. G., and ALDRICH, L. B. *On the use of the pyranometer.* Smithsonian Misc. Coll., **66**, No. 11. Pp. 9. 1916.

CLAYTON, H. H. *Effect of short period variations of solar radiation on the earth's atmosphere.* Smithsonian Misc. Coll., **68**, No. 3. Pp. 18. 1917.

COBLENTZ, W. W. *Application of the photoelectric cell as a pyrheliometer.* Phys. Rev., (2) **9**: See 572. 1917.

MERRILL, P. W. *Spectroscopic observations of stars of class Md.* Publ. Astron. Obs. Univ. Michigan, **2**: 45–70. 1916.

MERRILL, P. W. *A spectrum of the P Cygni type.* Publ. Astron. Obs. Univ. Michigan, **2**: 71–75. 1916.

MERRILL, P. W. *Discovery of two bright-line stars of class B.* Publ. Astron. Obs. Univ. Michigan, **2**: 181. 1916.

GEOPHYSICS

BAUER, L. A., and SWANN, W. F. G. *Results of atmospheric-electric observations made aboard the Galilee (1907—1908), and the Carnegie (1909–1916).* Carnegie Institution of Washington, Publication No. 175, 361–447. 1917.

BECKER, G. F. *Mechanics of the Panama Canal slides.* U. S. Geological Survey Professional Paper 98-N. Pp. 253–261. 1916.

JAGGAR, T. A. *Live aa lava at Kilauea.* Journ. Wash. Acad. Sci., **7**: 241–243. 1917.

LITTLEHALES, G. W. *In relation to the extent of knowledge concerning the oceanography of the Pacific.* Proc. National Acad. Sci., **2**: 419–421. 1916.

MARVIN, C. F. *Marine meteorology and the general circulation of the atmosphere.* Proc. National Acad. Sci., **2**: 421–424. 1916.

MERRILL, P. W. *The registration of earthquakes at the Detroit observatory during the years 1914 and 1915.* Publ. Astron. Obs. Univ. Michigan, **2**: 165–177. 1916.

MEUNIER, S. *A theory of terrestrial volcanoes and the geography of the moon.* Journ. Wash. Acad. Sci., **6**: 637–649. 1916.

SWANN, W. F. G. *On the origin of the earth's electric charge.* Phys. Rev., (2) **9**: 555–557. 1917.

Digitized by Google

Original from
HARVARD UNIVERSITY

TERRESTRIAL MAGNETISM

BAUER, L. A. *Annual report of the Director of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, 1916.* Carnegie Inst. Year Book, **15**: 287–336. 1917.

BAUER, L. A., and FISK, H. W. *On the results of some magnetic observations during the solar eclipse of August 21, 1914.* Journ. Terr. Mag., **21**: 57–86. 1916.

BAUER, L. A., and PETERS, W. J. *Some discussion of the ocean magnetic work, 1905–1916.* Carnegie Institution of Washington, Publication 175, 423–438. 1917.

BAUER, L. A., PETERS, W. J., AULT, J. P., and FLEMING, J. A. *The magnetic work of the Carnegie 1909–1916.* Carnegie Institution of Washington, Publication No. 175, 157–358. 1917.

BAUER, L. A., PETERS, W. J., and FLEMING, J. A. *The magnetic work of the Galilee, 1905–1908.* Carnegie Institution of Washington, Publication No. 175, 1–154. 1917.

HAZARD, D. L. *Activity of the earth's magnetism.* Terr. Mag. Atm. Elec., **22**: 84–86. 1917.

HAZARD, D. L. *Terrestrial Magnetism.* Amer. Year Book, **1916**: 603–604. 1917.

GEODESY

AVERS, H. G., and COWIE, G. D. *Precise leveling from Reno to Las Vegas, Nev., and from Tonopah Junction to Laws, Cal.* U. S. Coast and Geodetic Survey, Special Publication No. 39. Pp. 49. 1916.

JONES, E. L. *Use of mean sea level as the datum for elevations.* U. S. Coast and Geodetic Survey, Special Publication No. 41. Pp. 21. 1917.

GRAVITATION

BOWIE, W. *Investigations of gravity and isostasy.* U. S. Coast and Geodetic Survey, Special Publication No. 40. Pp. 196. 1917.

BRIGGS, L. J. *A new method of measuring the acceleration of gravity at sea.* Proc. National Acad. Sci., **2**: 399–407. 1916.

PHYSICS

AGNEW, P. G., STANNARD, W. H., and FEARING, J. L. *A system of remote control for an electric testing laboratory.* Bureau of Standards Scientific Paper No. 291 (Bull. Bur. Stds., **13**: 581–597). 1916.

BINGHAM, E. C., and JACKSON, R. F. *Standard substances for the calibration of viscometers.* Journ. Wash. Acad. Sci., **7**: 53–55. 1917; Bureau of Standards Scientific Paper No. 298 (Bull. Bur. Stds., **14**: 59–86.) 1917.

BAUER, L. A., and SWANN, W. F. G. *Experiments concerning "magnet-photography."* Phys. Rev., (2) **9**: 563–564. 1917.

BRIGGS, L. J. *The living plant as a physical system.* Journ. Wash. Acad. Sci., **7**: 89–111. 1917.

BROOKS, H. B., and WEAVER, F. C. *A variable self and mutual inductor.* Bureau of Standards Scientific Paper No. 290 (Bull. Bur. Stds., **13**: 569–580.) 1916.

Digitized by Google Original from HARVARD UNIVERSITY

Bureau of Standards. *Testing of clinical thermometers.* Bur. Stds. Circular No. 5, ed. 3. Pp. 20. 1917.

Bureau of Standards. *Fees for electric, magnetic, and photometric testing.* Bur. Stds. Circular No. 6, ed. 7. Pp. 30. 1916. (Contains information concerning the range and the precision of the usual tests and the conditions governing the acceptance of material for test.)

Bureau of Standards. *Electric units and standards.* Bur. Stds. Circular No. 60. Pp. 68. 1916.

Burrows, C. W. *The correlation of the mechanical and magnetic properties of steel.* Bureau of Standards Scientific Paper No. 272 (Bull. Bur. Stds., **15:** 173–210). 1916.

Burrows, C. W., and Sanford, R. L. *An experimental study of the Fahy permeameter.* Bureau of Standards Scientific Paper No. 306 (Bull. Bur. Stds., **14:** 267–300). 1917.

Coblentz, W. W. *The exudation of ice from the stems of plants.* The Scientific Monthly, **2:** 334–349. 1916.

Coblentz, W. W. *Some new designs of radiometers.* Journ. Wash. Acad. Sci., **6:** 473–475. 1916.

Coblentz, W. W. *Characteristics and comparative sensitiveness of various types of radiometers.* Journ. Wash. Acad. Sci., **7:** 164–165. 1917.

Coblentz, W. W. *The emissivity of straight and helical filaments of tungsten.* Bureau of Standards Scientific Paper No. 300 (Bull. Bur. Stds., **14:** 115–131). 1917; Elec. World, **69:** 329. 1917.

Coblentz, W. W., and Emerson, W. B. *Determinations of luminous efficiency and the mechanical equivalent of light.* Phys. Rev., (2) **9:** 569–570. 1917.

Coblentz, W. W., and Emerson, W. B. *Luminous radiation from a black body and the mechanical equivalent of light.* Bureau of Standards Scientific Paper No. 305 (Bull. Bur. Stds., **14:** 255–256). 1917.

Coblentz, W. W., and Emerson, W. B. *The relative sensibility of the average eye to light of different colors, and some practical applications to radiation problems.* Phys. Rev., (2) **9:** 87–88. 1917; Bureau of Standards Scientific Paper No. 303 (Bull. Bur. Stds., **14:** 157–236). 1917.

Coblentz, W. W., and Emerson, W. B. *Reflecting power of tungsten and stellite.* Bureau of Standards Scientific Paper No. 308 (Bull. Bur. Stds., **14:** 307–316). 1917.

Coblentz, W. W., and Emerson, W. B. *Glasses for protecting the eyes from injurious radiations.* Bureau of Standards Technologic Paper No. 93. Pp. 14. 1917.

Crittenden, E. C., and Richtmyer, F. K. *An "average eye" for heterochromatic photometry, and a comparison of a flicker and an equality of brightness photometer.* Trans. Soc. Illum. Eng., **11:** 331–356. 1916; Bureau of Standards Scientific Paper No. 299 (Bull. Bur. Stds., **14:** 87–113). 1917. (Slightly revised form of the 1916 paper.)

Dellinger, J. H. *Calculation of Planck's constant C_2.* Bureau of Standards Scientific Paper No. 387 (Bull. Bur. Stds., **13:** 535–546). 1916.

Dellinger, J. H. *The international system of electric and magnetic units.* Bureau of Standards Scientific Paper No. 292 (Bull. Bur. Stds., **13:** 599–631). 1916.

Dellinger, J. H. *Rationalization of the magnetic units.* Elec. World., **68:** 810. 1916; Electrician, **78:** 290. 1916.

Digitized by Google Original from HARVARD UNIVERSITY

DORSEY, N. E. *Luminescence measurements.* Journ. Wash. Acad. Sci., **7**: 1–6. 1917.

EDWARDS, J. D. *A specific gravity balance for gases.* Gas Record, **10**: 401–405. 1916; Bureau of Standards Technologic Paper No. 89. Pp. 20. 1917.

EDWARDS, J. D. *The effusion method of determining gas density.* Met. Chem. Engin., **16**: 518–524. 1917; Gas Age, **39**: 581–587. 1917; Bureau of Standards Technologic Paper No. 94. Pp. 30. 1917.

FOOTE, P. D. *A visibility equation derived from the Ives and Kingsbury new luminosity equation.* Journ. Wash. Acad. Sci., **7**: 317–318. 1917.

HERSCHEL, W. H. *Discussion of paper by H. C. Hayes and G. W. Lewis, The measurement of viscosity and a new form of viscosimeter.* Journ. Amer. Soc. Mech. Eng., **38**: 630. 1916.

HERSEY, M. D. *The theory of the torsion and the rolling ball viscosimeters, and their use in measuring the effect of pressure on viscosity.* Journ. Wash. Acad. Sci., **6**: 525–530. 1916.

HERSEY, M. D. *The measurement of viscosity.* Journ. Amer. Soc. Mech. Eng., **38**: 1002–1003. 1916.

HERSEY, M. D. *The theory of the stiffness of elastic systems.* Journ. Wash. Acad. Sci., **6**: 569–575. 1916.

HERSEY, M. D. *Note on an integrating device.* Journ. Wash. Acad. Sci., **6**: 617–620. 1916.

HERSEY, M. D. *Note on a relation connecting the derivatives of physical quantities.* Journ. Wash. Acad. Sci., **6**: 620–629. 1916.

JACKSON, R. F. *The saccharimetric normal weight and specific rotation of dextrose.* Bureau of Standards Scientific Paper No. 293 (Bull. Bur. Stds., **13**: 633–635). 1916.

MERRILL, P. W. *Wave-lengths of the stronger lines in the helium spectrum.* Bureau of Standards Scientific Paper No. 302 (Bull. Bur. Stds., **14**: 159–166.) 1917.

MUELLER, E. F. *Wheatstone bridges and accessory apparatus for resistance thermometry.* Bureau of Standards Scientific Paper No. 288 (Bull. Bur. Stds., **13**: 547–561). 1916.

NUTTING, P. G. *Criteria for gray radiation.* Journ. Wash. Acad. Sci., **6**: 476–478. 1916.

OSBORNE, N. S. *An aneroid calorimeter for specific and latent heats.* Bureau of Standards Scientific Paper No. 301 (Bull. Bur. Stds., **14**: 133–157). 1917.

PRIEST, I. G. *A proposed method for the photometry of lights of different colors.—II.* Phys. Rev., (2) **9**: 341–345. 1917.

PRIEST, I. G., and PETERS, C. G. *Measurement and specification of the physical factors which determine the saturation of certain tints of yellow.* Bureau of Standards Technologic Paper No. 92. Pp. 11. 1917.

RICHTMYER, F. K., and CRITTENDEN, E. C. *The precision of photometric measurements.* Phys. Rev., (2) **9**: 95–96. 1917.

ROESER, H. M. *Calculation of the constants of Planck's radiation equation: An extension of the theory of least squares.* Bureau of Standards Scientific Paper No. 304 (Bull. Bur. Stds., **14**: 237–253). 1917.

ROESER, H. M. *Note on the determination by judgment of the constants of linear empirical formulas.* Phys. Rev., (2) **9**: 80–83. 1917.

Digitized by Google

Original from
HARVARD UNIVERSITY

Rosa, E. B., and Vinal, G. W. *The silver voltameter as an international standard for the measurement of electric current.* Proc. National Acad. Sci., **3**: 59–64. 1917.

Sanford, R. L. *The determination of the degree of uniformity of bars for magnetic standards.* Bureau of Standards Scientific Paper No. 295 (Bull. Bur. Stds., **14**: 1–14). 1916.

Silsbee, F. B. *A note on electrical conduction in metals at low temperature.* Journ. Wash. Acad. Sci., **6**: 597–602. 1916; Bureau of Standards Scientific Paper No. 307 (Bull. Bur. Stds., **14**: 301–306.) 1917.

Stillman, M. H. *The damping of waves and other disturbances in mercury.* Bureau of Standards Scientific Paper No. 289 (Bull. Bur. Stds., **13**: 563–568). 1916.

Stratton, S. W. *Annual report of the Director of the Bureau of Standards for the fiscal year ending June 30, 1916.* Pp. 165. 1916.

Swann, W. F. G., and Mauchly, S. J. *On the conduction of electricity through an ionized gas, more particularly in its relation to Bronson resistances.* Terr. Mag. Atm. Elec., **22**: 1–21. 1917.

Weibel, E. *A study of electromagnet moving coil galvanometers for use in alternating current measurements.* Bureau of Standards Scientific Paper No. 297 (Bull. Bur. Stds., **14**: 23–58). 1917.

Wilhelm, R. M. *The freezing point of mercury.* Bureau of Standards Scientific Paper No. 294 (Bull. Bur. Stds., **13**: 655–661). 1916.

Woodward, R. W., and Harrison, T. R. *Note on the thermocouple nichrome constantan.* Met. Chem. Eng., p. 647. June 1, 1917.

Wright, F. E. *Recent improvements in the petrographic microscope.* Journ. Wash. Acad. Sci., **6**: 465–472. 1916.

CHEMISTRY

v. Bichowsky, F. R. *The electrometric titration of zinc with ferrocyanide.* Journ. Wash. Acad. Sci., **7**: 141–143. 1917.

Clark, W. M., and Lubs, H. A. *The colorimetric determination of the hydrogen-ion concentration of bacteriological culture media.* Journ. Wash. Acad. Sci., **6**: 483–489. 1916.

Ferguson, J. B. *The equilibrium between carbon monoxide, carbon dioxide, sulfur dioxide, and free sulfur.* Proc. National Acad. Sci., **3**: 371–374. 1917.

Lubs, H. A., and Clark, W. M. *A note on the sulphonephthaleins as indicators for the colorimetric determination of hydrogen-ion concentration.* Journ. Wash. Acad. Sci., **6**: 481–483. 1916.

Morey, G. W. *A convenient form of autoclave.* Journ. Wash. Acad. Sci., **7**: 205–208. 1917.

Rawdon, H. S. *Note on the occurrence and significance of twinned crystals in electrolytic copper.* Amer. Inst. Metals, vol. 10. 1916.

Sosman, R. B. *The common refractory oxides.* Journ. Indust. Eng. Chem., **8**: 985–999. 1916.

Sosman, R. B. *Some problems of the oxides of iron.* Journ. Wash. Acad. Sci., **7**: 55–72. 1917.

Digitized by Google Original from HARVARD UNIVERSITY

SOSMAN, R. B., and HOSTETTER, J. C. *The ferrous iron content and magnetic susceptibility of some artificial and natural oxides of iron.* Trans. Amer. Inst. Mining Eng., **53**: 907–931. 1917.

SOSMAN, R. B., and HOSTETTER, J. C. *Zonal growth in hematite, and its bearing on the origin of certain iron ores.* Trans. Amer. Inst. Mining Eng., **53**: 933–943. 1917.

METALLOGRAPHY

BURGESS, G. K. *Temperature measurements in Bessemer and open hearth practice.* Bureau of Standards Technologic Paper No. 91. Pp. 29. 1917.

BURGESS, G. K., and SCOTT, H. *Thermoelectric measurement of the critical ranges of pure iron.* Journ. Wash. Acad. Sci., **6**: 650–651. 1916; Bureau of Standards Scientific Paper No. 296 (Bull. Bur. Stds., **14**: 15–21). 1917.

MERICA, P. D. *The failure of brass.—2. The effect of corrosion on the ductility and strength of brass.* Bureau of Standards Technologic Paper No. 83. Pp. 7. 1916.

MERICA, P. D. *The structure of the coating on tinned sheet copper in relation to a curious case of corrosion of this material.* Bureau of Standards Technologic Paper No. 90. Pp. 18. 1917.

MERICA, P. D., and KARR, C. P. *The failure of brass.—3. Initial stress produced by the burning in of manganese bronze.* Bureau of Standards Technologic Paper No. 84. Pp. 7. 1916.

MERICA, P. D., and WOODWARD, R. W. *The failure of brass.—1. Microstructure and initial stresses in wrought brasses of the type 60 per cent copper and 40 per cent zinc.* Bureau of Standards Technologic Paper No. 82. Pp. 72. 1917.

TECHNOLOGY

AHLBORN, G. H. *Data on electric railway track leakage.* Bureau of Standards Technologic Paper No. 75. Pp. 22. 1916.

BATES, P. H., and KLEIN, A. A. *Properties of the calcium silicates and calcium aluminate occurring in Portland cement.* Bureau of Standards Technologic Paper No. 78. Pp. 34. 1917.

BEARCE, H. W., and PEFFER, E. L. *The density and thermal expansion of American petroleum oils.* Bureau of Standards Technologic Paper No. 77. Pp. 26. 1916.

BLEININGER, A. V., and SCHURECHT, H. G. *The properties of some European plastic fire clays.* Bureau of Standards Technologic Paper No. 79. Pp. 34. 1916.

BLUME, W., HOLLER, H. D., and RAWDON, H. S. *Preliminary studies in the deposition of copper in electroplating baths.* Trans. Amer. Electrochem. Soc., **30**: 159–174. 1916.

BOUGHTON, E. W. *Effect of certain pigments on linseed oil.* Bureau of Standards Technologic Paper No. 71. Pp. 16. 1916.

BOUGHTON, E. W. *Determination of volatile thinner in oil varnish.* Bureau of Standards Technologic Paper No. 76. Pp. 7. 1916.

BUREAU OF STANDARDS. *Report on the tenth annual Conference on Weights and Measures, May 25–28, 1915.* Bur. Stds. Special Publication. Pp. 254. 1916.

Digitized by Google Original from HARVARD UNIVERSITY

Bureau of Standards. *United States Government specification for Portland cement.* Bur. Stds. Circular No. 33, ed. 3. Pp. 43. 1917.

Bureau of Standards. *National electrical safety code.* Bur. Stds. Circular No. 54, ed. 2. Pp. 323. 1916.

Bureau of Standards. *Standards for electric service.* Bur. Stds. Circular No. 56. Pp. 262. 1916.

Bureau of Standards. *Specifications and tolerances for weights and measures and weighing and measuring devices.* Bur. Stds. Circular No. 61. Pp. 44. 1916.

Bureau of Standards. *Specifications for and methods of testing soaps.* Bur. Stds. Circular No. 62. Pp. 25. 1916.

Bureau of Standards. *Specification and tests of the transparency of paper and tracing cloth.* Bur. Stds. Circular No. 63. Pp. 8. 1917.

Bureau of Standards. *Rules and regulations for enforcement of lime-barrel act.* Bur. Stds. Circular No. 64. Pp. 70. 1917.

Bureau of Standards. *Gas calorimeter tables.* Bur. Stds. Circular No. 65. Pp. 19. 1917.

Bureau of Standards. *Standard samples for thermometric fixed points.* Bur. Stds. Circular No. 66. Pp. 13. 1917. (Describes the methods of preparation and the chemical analyses of the metals, tin, zinc, aluminium, and copper, which have been prepared for distribution.)

Cain, J. R., and Rawdon, H. S. *Report on the investigation of ladle-test steel ingots.* Proc. Amer. Soc. Test. Mater., **16**: 129–144. 1916.

Emley, W. E. *The manufacture and properties of sand-lime brick.* Bureau of Standards Technologic Paper No. 85. Pp. 41. 1917.

Herschel, W. H. *Discussion of the report of committee D-4 on road materials.* Proc. Amer. Soc. Test. Mater., **16**: 316. 1916.

Herschel, W. H. *Quantitative test for resistance of lubricating oils to emulsification.* Proc. Amer. Soc. Test. Mater., **16**: 248. 1916.

Herschel, W. H. *Testing of lubricating oils; an address delivered before the Independent Oil Mens Association, Chicago, Oct. 19, 1916.* Oildom, **6**: 590. 1916.

Herschel, W. H. *Design of a water brake.* Power, p. 133. 1916; Engineering News, p. 378. 1916.

Herschel, W. H. *The testing and standardization of lubricating oils.* Oil, Paint, and Drug Reporter, **91**: 14. 1917.

Herschel, W. H. *Notes on speed indicators for airplanes. The Pitot tube.* Aviat. and Aeronaut. Eng., p. 384. 1917.

Herschel, W. H. *Note on speed indicators for airplanes. The Venturi tube.* Aviat. and Aeronaut. Eng., Feb. 15, 1917.

Herschel, W. H. *The resistance of an oil to emulsification.* Bureau of Standards Technologic Paper No. 86. Pp. 37. 1917.

Klein, A. A. *The constitution and microstructure of porcelain.* Journ. Wash. Acad. Sci., **6**: 658–660. 1916; Bureau of Standards Technologic Paper No. 80. Pp. 38. 1916.

Lewis, W. S. *Comparative tests of stitches and seams.* Bureau of Standards Technologic Paper No. 96. Pp. 19. 1917.

McCullom, B., and Ahlborn, G. H. *Influence of frequency of alternating or infrequently reversed current on electrolytic corrosion.* Bureau of Standards Technologic Paper No. 72. Pp. 31. 1916.

Digitized by Google

Original from HARVARD UNIVERSITY

Rosa, E. B., Brooks, H. B., McCullom, B., Canada, W. J., and Gladding, F. W. *An investigation of cartridge enclosed fuses.* Bureau of Standards Technologic Paper No. 74. Pp. 199. 1916.

Schlink, F. J. *Liquid-measuring pumps.* Bureau of Standards Technologic Paper No. 81. Pp. 27. 1916.

Schlink, F. J. *A simple and accurate balance for the shop.* Machinery, pp. 413–414, Jan., 1917.

Smith, W. H. *Recovery of paraffin and paper stock from waste paraffin paper.* Bureau of Standards Technologic Paper No. 87. Pp. 4. 1916.

Smith, W. H. *Studies on paper pulp.* Bureau of Standards Technologic Paper No. 88. Pp. 13. 1917.

Waters, C. E. *Further data on the oxidation of automobile cylinder oils.* Bureau of Standards Technologic Paper No. 73. Pp. 20. 1916.

Wig, R. J., Pearson, J. C., and Emley, W. E. *Durability of stucco and plaster construction.* Bureau of Standards Technologic Paper No. 70. Pp. 74. 1917.

Wig, R. J., Williams, G. M., Finn, A. N., McCrory, S. H., Bebb, E. C., and Ferguson, L. R. *Durability of cement drain tile and concrete in alkali soil.* Bureau of Standards Technologic Paper No. 95. Pp. 94. 1917. (Supersedes Technologic Paper No. 44.)

Digitized by Google

Original from
HARVARD UNIVERSITY

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 787th meeting was held at the Cosmos Club, March 31, 1917. President BUCKINGHAM in the chair; 36 persons present. The minutes of the 786th meeting were read in abstract and approved.

The following resolution was unanimously adopted:

Resolved: That the Philosophical Society of Washington endorses the movement to extend the use of the metric system and commends the efforts of the American Metric Association to this end.

Mr. FREDERICK BATES and Mr. F. P. PHELPS gave an illustrated paper on *The rotation of the plane of polarization in quartz and iron at high temperatures.*

Curves showing the results of precision measurements for both the natural and the magnetic rotation of the plane of polarization in quartz for a temperature range from 20°C. to 1000°C. were exhibited. Quartz recrystallizes at about 575°C. changing from α to β quartz. The curve for the variation of the natural rotation with the temperature makes a right angle turn at this point and shows evidence of a discontinuity. In contrast to the natural rotation the magnetic rotation shows no change at 575° and has no temperature coefficient. For measuring the rotations a large Weiss, water-cooled electromagnet was used. The furnace was placed between the poles of the magnet and the temperature was obtained by means of a standard thermocouple. Monochromatic light of high intensity was passed through the plate parallel to the magnetic field. Similar curves for the magnetic rotation in films of electrolytic iron and iron oxides were also shown. The results indicate that the optical phenomena disappear at the temperature at which the metal loses its magnetic properties.

Discussion. The paper was discussed by Messrs. WHITE and WRIGHT. Mr. G. K. BURGESS spoke of the possibility of harmonizing results showing the magnetic rotation of films of iron which had become oxidized, by disregarding the oxygen and considering only the iron present.

Mr. F. E. WRIGHT gave an illustrated paper on *The application of polarized light to the study of opaque substances.*

Mr. P. V. WELLS gave an illustrated paper on *A standard of turbidity.* The speaker described briefly the physical properties of turbid media, pointing out that such media are usually in a critical state. Their most striking characteristic is that of scattering light, the effect vary-

Digitized by Google Original from HARVARD UNIVERSITY

ing rapidly with small changes in the other variables, such as temperature or pressure. The factors determining the intensity of the scattered light in the simple case of particles small compared with the wave length of the light were given after the treatment of Rayleigh.

Turbidimetry is chiefly concerned with the measurement of the mass of suspended matter, but, as this is small and its accurate determination difficult, optical measures have frequently been adopted for rapid work. The most definite of these is the intensity of the light scattered in a fixed direction from a layer of turbid medium of definite thickness, illuminated by a parallel incident beam. The logical measure would be the ratio of the scattered and incident intensity. Provisionally, however, the scattered intensity was compared with the intensity of the light diffusely reflected normally from a magnesia surface with the same parallel beam incident at 45°. The magnesia surface was made by depositing the smoke from burning magnesium ribbon upon thin plate glass. The magnesia-glass surface was used because its direction could be determined. It was accurately reproducible. A turbidimeter was described, by means of which these measurements could be made. The readings obtained with doubly distilled water, with turbid liquids, and with air, both pure and vitiated with smoke, were given.

Discussion. Mr. Wright inquired as to the possibility of using the scattering of a beam of polarized light, as measured by the amount of light emerging polarized at right angles to the plane of the entering beam, as an indication of turbidity. Mr. Wells stated that such effects would vary with the size of the suspended particles. Mr. Merwin inquired as to the distribution of the light scattered from the magnesia reference plate. Mr. Wells stated that it had not been measured, but that it probably followed Lambert's law closely. Mr. Bates spoke of the difficulty of producing a perfectly clear fluid, with especial reference to some attempts to remove all suspended particles from oil.

The 788th meeting was held at the Cosmos Club, April 19, 1917. President Buckingham in the chair; 85 persons present.

The entire evening was devoted to hearing an address by Dr. Irving Langmuir on *The constitution of liquids.* (No abstract.) A paper dealing with the subject matter presented will be found in the Proc. National Acad. Sci., 3: 251–257. 1917.

Discussion. The paper was discussed by Messrs. Sparrow, Buckingham, Swann, and Hersey, and by Messrs. T. C. Mendenhall and R. A. Millikan with especial reference to the questionable but persistent idea of a spherical atom.

The 789th meeting was held at the Cosmos Club, April 28, 1917. Vice President Humphreys in the chair; 39 persons present. The minutes of the 787th and 788th meetings were read in abstract and approved.

Digitized by Google Original from HARVARD UNIVERSITY

The Secretary read the call for the first meeting of the Society and the list of charter members.

Mr. WILLIAM H. DALL delivered an address on *The origin and early days of the Philosophical Society of Washington.* The address will probably be published in full in this JOURNAL at a later date.

The Secretary read a letter from Mr. G. K. GILBERT, the second oldest member of the Society, conveying his best wishes and expressing regret that it was impossible for him to be present at the meeting.

Mr. F. W. CLARKE delivered an address on *The development of scientific societies in Washington.*

Interesting reminiscences of the early days of the society were offered by Messrs. HOWARD, FARQUHAR, WEAD, and BAUER.

The 790th meeting was held at the Cosmos Club, May 12, 1917 President BUCKINGHAM in the chair; 28 persons present. The minutes of the 789th meeting were read in abstract and approved.

Messrs. I. G. PRIEST and C. G. PETERS gave an illustrated paper on *An interferential method for measuring the expansion of very small samples.* This paper describes a method requiring as a sample only *one* small pin about 5 mm. in diameter by 10 mm. long, or even of smaller dimensions. Briefly the outline of the method is as follow:

1. One of a pair of nearly (but not quite) parallel interferometer mirrors is supported at one point by the sample and at two other points by a standard substance of known expansivity.

2. Any difference in the expansivity of the sample and the standard causes the interference fringes to change their *widths* with changing temperature. This change in width is measured, and from it the relative expansion is computed.

Noteworthy advantages of this method over the Fizeau-Pulfrich method are:

1. Smallness of sample required.

2. Elimination of the difficulty of obtaining the interference fringe data. It is not necessary to count the passage of fringes during the temperature change nor to make measurements on fringes of more than one wave length.

3. The very troublesome correction for change in the refractive index of air with temperature is eliminated.

It is expected that a fuller description of this method will appear later as a Scientific Paper of the Bureau of Standards.

Discussion. The paper was discussed by Messrs. BUCKINGHAM and HUMPHREYS.

By invitation Mr. J. D. EDWARDS gave an illustrated paper on *The rapid determination of gas density.*

Because of their importance in connection with orifice meter measurements and other technical and scientific problems, methods for the rapid determination of gas density have been investigated at the Bureau of Standards.

Digitized by Google Original from HARVARD UNIVERSITY

The effusion method which has been widely used for this purpose has been shown to be unreliable, errors of over 10 per cent not being unusual in practice. A study of the theory of the effusion process has revealed the main sources of error in this method. The effusion method under the most favorable conditions can probably not be relied on to better than 1 or 2 per cent.

In order to secure precise results a specific gravity balance employing an indirect weighing method was developed; this enables one to secure results accurate to about 0.2 per cent. This apparatus is convenient to use, may be made portable, and requires no preliminary calibration.

Discussion. The paper was discussed by Messrs. PRIEST, HERSEY, SWEET, BUCKINGHAM, and HUMPHREYS.

Informal communications: Mr. BUCKINGHAM outlined a theory accounting for the errors in the effusion method of determining gas densities.

Mr. C. A. BRIGGS exhibited two combination time and percussion caps for shrapnel shells of types now in use on the Russian battle front.

Mr. H. F. STIMSON exhibited a 2-stage mercury vapor condensation pump for operating between about 4 cm. and 0.0004 mm. of mercury. The low pressure stage is built with a long nozzle of the De Laval type and the high pressure with a short nozzle. In each nozzle the ratio of the higher to the lower pressure is maintained above the critical value of about 2, and the velocity of the vapor in the nozzle is greater than the velocity of sound.

DONALD H. SWEET, *Secretary.*

Digitized by Google Original from HARVARD UNIVERSITY

REPRINT OF HEREDITY LECTURES

A series of three public lectures by Prof. H. S. Jennings, Dr. Oscar Riddle, and Prof. W. E. Castle, dealing with the subject of heredity, was given under the auspices of the Washington Academy of Sciences during March and April, 1917. In view of the wide-spread interest in the lectures, and in response to numerous requests, the Academy has reprinted in collected form a limited edition of the lectures as published in the JOURNAL.

Copies of the brochure, substantially bound in flexible cloth covers, may be purchased of the Treasurer, Mr. William Bowie, Coast and Geodetic Survey, Washington, D. C., at fifty cents each (postage included).

Digitized by Google

Original from
HARVARD UNIVERSITY

CONTENTS

Original Papers

Page

Physics.—Note on the vibration frequencies of elastic systems. M. D. Hersey ... 437

Crystal Optics.—Dispersion and other optical properties of carborundum. H. E. Merwin ... 445

Mineralogy.—The nomenclature and classification of the native element minerals. Edgar T. Wherry ... 447

Mineralogy.—The crystal form of spencerite. T. L. Walker ... 456

Ethnology.—A prehistoric stone mortar from southern Arizona. J. Walter Fewkes ... 459

Abstracts

Technology ... 464

References

Astrophysics ... 465
Geophysics ... 465
Terrestrial Magnetism ... 466
Geodesy ... 466
Gravitation ... 466
Physics ... 466
Chemistry ... 469
Metallography ... 470
Technology ... 470

Proceedings

The Philosophical Society of Washington ... 473

Digitized by Google
Original from HARVARD UNIVERSITY

SOC. 120. 146. 230.15

LIBRARY
PEABODY MUSEUM
RECEIVED
NOV 3 1955

Vol. VIII | No. 6

March 19, 1918

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

BOARD OF EDITORS

Adolph Knopf
GEOLOGICAL SURVEY

A. S. Hitchcock
BUREAU OF PLANT INDUSTRY

J. Franklin Meyer
BUREAU OF STANDARDS

PUBLISHED SEMI-MONTHLY
EXCEPT IN JULY, AUGUST, AND SEPTEMBER, WHEN MONTHLY

BY THE

WASHINGTON ACADEMY OF SCIENCES

OFFICE OF PUBLICATION
WILLIAMS & WILKINS COMPANY
BALTIMORE, MD.

Entered as second-class matter July 14, 1911, at the post office at Baltimore, Maryland, under the Act of July 16, 1894

Digitized by Google

Original from
HARVARD UNIVERSITY

Journal of the Washington Academy of Sciences

This JOURNAL, the official organ of the Washington Academy of Sciences, aims to present a brief record of current scientific work in Washington. To this end it publishes: (1) short original papers, written or communicated by members of the Academy; (2) a complete list of references to current scientific articles published in or emanating from Washington; (3) short abstracts of certain of these articles; (4) proceedings and programs of meetings of the Academy and affiliated Societies; (5) notes of events connected with the scientific life of Washington. The JOURNAL is issued semi-monthly, on the fourth and nineteenth of each month, except during the summer when it appears on the nineteenth only. Volumes correspond to calendar years. Prompt publication is an essential feature; a manuscript reaching the editors on the second or the seventeenth of the month will ordinarily appear, on request from the author, in the next issue of the JOURNAL.

Manuscripts may be sent to any member of the Board of Editors; they should be clearly typewritten and in suitable form for printing without essential changes. The editors cannot undertake to do more than correct obvious minor errors. References should appear only as footnotes and should include year of publication.

Illustrations will be used only when necessary and will be confined to text figures or diagrams of simple character. The editors, at their discretion, may call upon an author to defray the cost of his illustrations, although no charge will be made for printing from a suitable cut supplied with the manuscript.

Proof.—In order to facilitate prompt publication no proof will be sent to authors unless requested. It is urged that manuscript be submitted in final form; the editors will exercise due care in seeing that copy is followed.

Authors' Copies and Reprints.—On request the author of an original article will receive gratis ten copies of the number containing his contribution and as many additional copies as he may desire at ten cents each. Reprints will be furnished at the following schedule of prices:

	4 pp.	8 pp.	12 pp.	16 pp.
50 copies	$1.08	$1.95	$2.93	$3.80
100 copies	1.30	2.40	3.60	4.70
Additional copies, per 100	.45	.90	1.35	1.70

Covers bearing the name of the author and title of the article, with inclusive pagination and date of issue, will be $2.00 for the first 100. Additional covers $1.00 per 100.

As an author may not see proof, his request for extra copies or reprints should invariably be attached to the first page of his manuscript.

The rate of Subscription per volume is	$6.00*
Semi-monthly numbers	.25
Monthly numbers	.50

Remittances should be made payable to "Washington Academy of Sciences," and addressed to the Treasurer, William Bowie, Coast and Geodetic Survey, Washington, D. C., to Williams & Wilkins Company, 2419–2421 Greenmount Ave., Baltimore, Md., or to the European Agents.

European Agents: William Wesley & Son, 28 Essex St., Strand, London, and Mayer and Müller, Prinz Louis-Ferdinand Str., Berlin.

Exchanges.—The JOURNAL does not exchange with other publications.

Missing Numbers will be replaced without charge, provided that claim is made within thirty days after date of the following issue.

* Volume I, however, from July 19, 1911, to December 19, 1911, will be sent for $3.00. Special rates are given to members of scientific societies affiliated with the Academy.

THE WAVERLY PRESS
BALTIMORE, U. S. A.

Digitized by Google
Original from
HARVARD UNIVERSITY

JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. VIII MARCH 19, 1918 No. 6

OCEANOGRAPHY.—*An electrical instrument for recording sea-water salinity.*[1] ERNEST E. WEIBEL and ALBERT L. THURAS, Bureau of Standards. (Communicated by S. W. Stratton.)

The modern tendency in physical research is to replace indicating instruments by recording instruments wherever possible. This has been especially true in the science of meteorology, where the recent advances have been brought about almost entirely by the remarkable improvements and developments in recording instruments. In the related science of oceanography there are practically no recording instruments now in general use, except possibly the tide-gage. If meteorology has been so greatly benefited by such instruments, surely in oceanography, where the changes in the physical properties are so much more regular and therefore more easily interpreted, great advances should be looked for through the addition or substitution of recording instruments.

A few years ago a recorder using a platinum resistance thermometer,[2] giving a continuous record of the surface temperature of the ocean, was designed and constructed at the Bureau of Standards. This instrument has been used successfully on board ship and some very interesting records have been obtained which show the distribution of temperature and thereby indicate the location of ocean currents and also give a knowledge

[1] Done under the auspices of the Interdepartmental Committee on Oceanography, subcommittee on instruments, apparatus, and measurements.

[2] WAIDNER, DICKINSON, and CROWE. Bureau of Standards Bull. 10: 267. 1914.

Digitized by Google

Original from HARVARD UNIVERSITY

of their boundary conditions which could hardly be obtained by repeated single measurements of temperature.

The temperature, however, is not nearly so reliable a clue to the location of currents and the origin of water masses as is the salinity. A body of sea water may change considerably in temperature in moving from one place to another, but unless the evaporation or rainfall is excessive its concentration will change comparatively little. By salinity is meant the number of grams of salt or solids in one kilogram of sea water. The composition of these salts is very nearly constant everywhere in the open ocean, but the salinity, or concentration of the total salts, varies from place to place.

From a consideration of the properties of sea water that vary with the salinity, the electrical conductivity seemed to be the most susceptible to continuous measurement, if the difficulty due to the variation of conductivity with temperature can be overcome. This difficulty is avoided by the use of a method which is compensated for temperature.

This paper describes the method of measurement and the experimental work done towards the production of an apparatus to give a continuous record of sea-water salinity to the accuracy required in the most precise oceanographic research. The work has not been finished, but from the results obtained we believe that the method is practical and sufficiently important to warrant publication at the present time, even though the apparatus is not yet built.

DESCRIPTION OF THE METHOD

The method consists in measuring the ratio of the resistance of sea water in two equal or nearly equal electrolytic cells *A* and *B* (fig. 1); one cell *A* is sealed and contains sea water of a known average salinity, the other cell *B* is open and has flowing through it the sea water to be measured. This ratio is obtained by a Wheatstone bridge using alternating current to eliminate polarization effects in the cells. A calibration of the apparatus can be made at any time by using sea water of known salinity in the

Digitized by Google
Original from HARVARD UNIVERSITY

open cell. This can be done either by carrying standard samples or by determining the salinity of the sea water flowing through the open cell by some accurate method that can be used on board ship. Such a method giving salinity by a measurement of density has been described.[3] A record of the resistance ratio of the two cells is made by a recorder similar to those now in use for measuring temperature, but some changes will have to be made to adapt it for using alternating current.

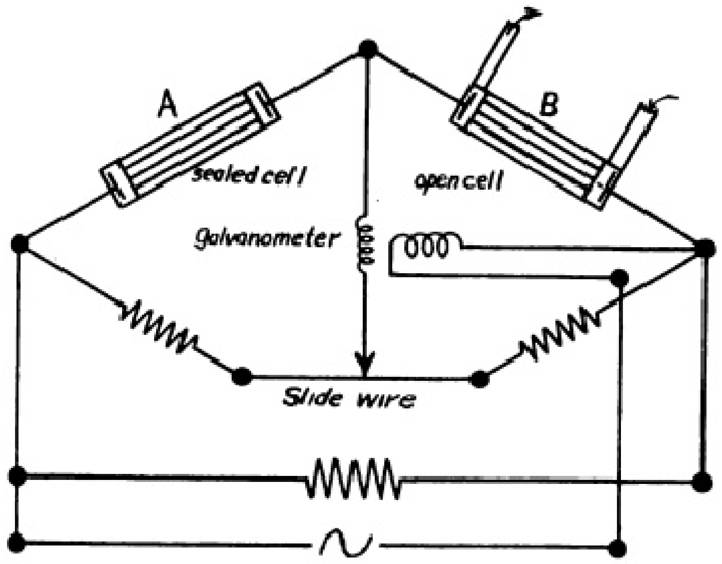


Fig. 1.

The new and important feature of this method is the use of two cells containing liquids of nearly the same properties, which make it possible to compensate almost completely for the large temperature coefficient of sea water. The two cells are placed in a uniform temperature bath and the error will be only that due to the small differential temperature coefficient of the two solutions.

EXPERIMENTAL WORK

Preliminary experiments to test the general feasibility of the method showed:

1. Good balances can be obtained with a simple Wheatstone

[3] Thuras, A. L., Journ. Wash. Acad. Sci. 7: 605. 1917.

Digitized by Google Original from HARVARD UNIVERSITY

bridge circuit containing the two electrolytic cells, using either a telephone at 500 cycles per second or an alternating current galvanometer at 60 cycles per second as a detector.

2. The temperature compensation is sufficient. For the maximum difference in salinity the lack of compensation did not exceed 0.03 in salinity (0.03 gram of solids per kilogram of water) for a change of 10°C.

3. No appreciable change in balance due to the flow of the sea water through the open cell was obtained.

4. To obtain a continuous record of salinity an alternating-current galvanometer similar to the usual direct-current galvanometer is needed to operate the recorder. This galvanometer was constructed of the electromagnet moving coil type,[4] and had a sensitivity and other operating constants as good as those of the direct-current galvanometers now used. After these preliminary experiments on some temporary cells had shown the feasibility of the method a more careful study was made of certain sources of error in order to obtain data upon which to base the design of the final cells. These effects are:

1. Heating effect of the current in the cells;

2. Temperature lag of the sealed cell when the sea-water temperature in the bath suddenly changes;

3. Time necessary for the resistance ratio to reach its true value if the sea water passing through the open cell changes in salinity.

In the ordinary conductivity measurements performed in a laboratory the heating effect of the current can be made negligible by using a sufficiently sensitive galvanometer or telephone receiver, but with the less sensitive recording galvanometer this current must be much larger and consequently requires a specially designed cell to dissipate the heat developed. From experiments on differently shaped cells the heating coefficients, i.e., temperature rise per watt dissipated in the cells, were found to be approximately inversely proportional to the diameters and lengths of the cells. Since the length of cell is limited by

[4] WEIBEL, E. E., Bureau of Standards Sci. Paper No. 297. p. 23. 1917.

Digitized by Google Original from HARVARD UNIVERSITY

practical considerations, it was necessary to increase the diameter in order to reduce this coefficient.

To determine the temperature lag, different cells were placed in a stirred bath and their time constants were found by changing their temperatures slightly from the temperature of the bath and reading the resistance at definite intervals as the cell gradually assumed the temperature of the bath. By time constant is here meant the time necessary for the temperature of the cell to approach the temperature of the bath to 67 per cent of its initial difference in temperature.

The time constants were found to be very approximately inversely proportional to the square of the diameter of the cells. Therefore the condition that is required to reduce the heating coefficient is opposite to that which will reduce the time constant, and since both of these values must be small special *multiple tube* cells were designed which will fulfill these conditions.

The time lag produced by a change in concentration of the sea water was determined by passing water of different salinities through a cell and it was found that if the cell is being swept out at the rate of three or four volumes a minute the ratio will respond within three or four minutes for probably the maximum change in salinity which can occur. The following considerations will show the purpose of reducing these factors as much as possible.

In general the temperature and salinity of the ocean changes very gradually from place to place so that usually no special cell would be required to record the salinity, but at some places as for instance in the vicinity of the Grand Bank of Newfoundland, where the cold fresh water of the Labrador Current meets the warm salty water of the Gulf Stream, the temperature and salinity change comparatively rapidly in moving from one body of water to the other. At these places such a specially designed cell is necessary. A few years ago a number of temperature records of the ocean were taken from a vessel going at moderate speeds and the most sudden change in temperature was 3.5° in about one minute. If this change is assumed to be instantaneous, the temperature of the sealed cell will in less than two min-

Digitized by Google Original from HARVARD UNIVERSITY

utes be so near that of the open cell that the error will be less than 0.02 in salinity.

Although there are as yet no observations on the rate of change of salinity, it is assumed that the maximum change in a short interval of time is not greater than 2 in salinity. This value is estimated from the relative changes of temperature which are discussed above. A response to this change to within 0.02 in salinity in less than two minutes can be obtained by washing out the cell at the rate of 3 or 4 volumes a minute. However, if the temperature and salinity change at the same time, which is

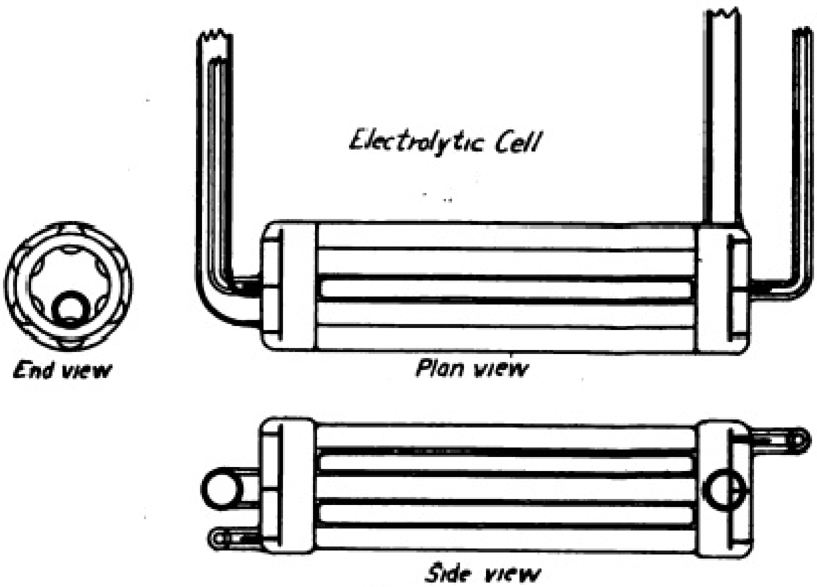


Fig. 2.

quite probable, the lag of the recorder will be the sum of the two and if they are both a maximum at the same time, which is quite improbable, then the total time lag will be 4 minutes. This is probably the worst possible condition that can occur, but it is well to point out that as the regain of the true reading is exponential the recorder will at first quickly approach its correct value and although it takes four minutes to reach within 0.02 in salinity it will take much less than two minutes to obtain an accuracy of 0.04 in salinity. However, if a more careful study of the change in salinity between different water masses

Digitized by Google Original from HARVARD UNIVERSITY

is required it is only necessary to increase the flow through the open cell and to make a correction for the error caused by the rapid change in temperature. Since another recorder will be used to measure the temperature of the sea water this temperature correction for the salinity can easily be obtained.

MULTIPLE TUBE CELLS

Each of the 2 cells that have been designed (fig. 2) contains 6 parallel glass tubes 14 cm. long and 1 cm. in diameter. These tubes are joined at each end to bulbs containing annular-shaped platinum electrodes. Each electrode has an area of 5.3 sq. cm. and is held rigidly in place by 4 platinum pins which are welded to the electrode and sealed into the glass wall of the cell. The cells are designed so that there are no pockets in which air can collect, and the sea water is admitted in such a manner as to sweep off any bubbles that might collect on the electrodes. The inlet and outlet tubes are sufficiently large to insure a thorough washing out of the cell in sufficient time to respond to the maximum changes in salinity that are liable to be met with on a vessel running at moderate speed.

RECORDER

In order to obtain a continuous record of sea-water salinity the Wheatstone bridge and galvanometer must be embodied in a recorder mechanism such as that developed by the Leeds & Northrup Company. The most important changes in their present recorder are due to the use of alternating current. The electrical connections are as shown in fig. 1. The current may be obtained from the usual 60-cycle supply, but if only direct current is available then the small direct-current motor used for driving the recorder mechanism can be equipped with slip rings and be operated as a converter. The recorder paper should be ruled so that salinities can be read directly.

INSTALLATION AND OPERATION ON BOARD SHIP

To obtain a continuous record of surface salinity, the apparatus will be set up similarly to the temperature-recording appara-

Digitized by Google Original from HARVARD UNIVERSITY

tus previously used.[5] The recorder will be properly secured in a convenient place on the vessel and insulated wires will lead from it to the cells. The cells (see fig. 3) will be mounted close together in a bath through which water direct from the ocean will flow continuously. This will insure a uniform temperature throughout the bath. A flow of water will also be maintained

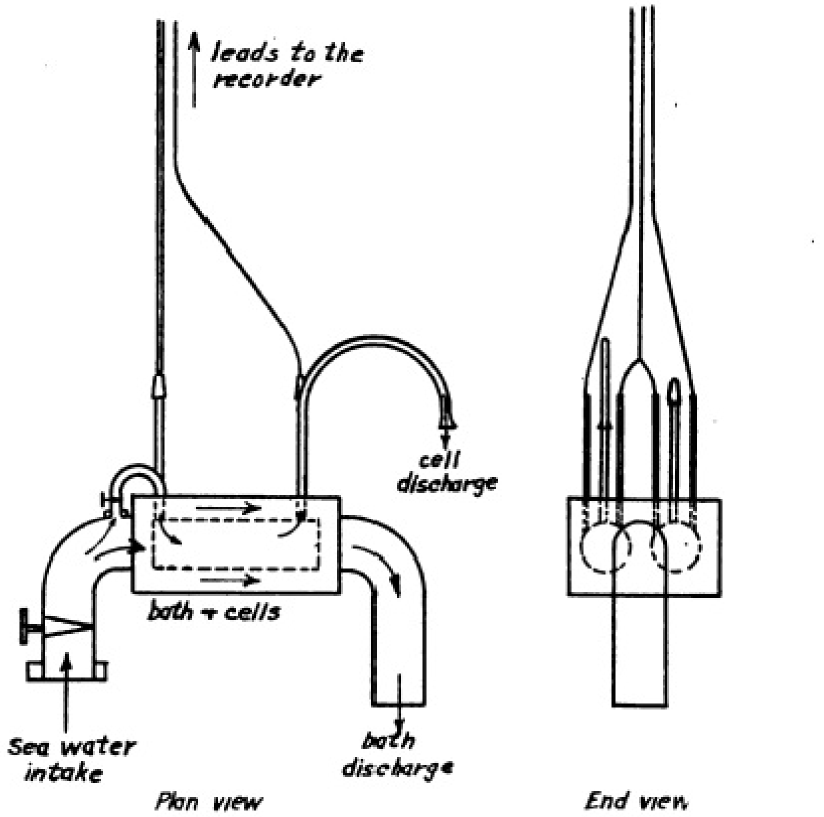


Fig. 3.

through the open cell, this water being tapped off from the main supply which passes through the bath. This flow must be broken as it leaves the cell in order to eliminate the resistance error due to shunting the open cell. The bath and connections to the sea-water supply will be carefully covered with heat insulating material to insure a uniform temperature throughout.

[5] Treasury Dept., U. S. Coast Guard Bull. 5: 27. 1915.

Digitized by Google Original from HARVARD UNIVERSITY

SUMMARY

An apparatus to give a continuous record of sea-water salinity by the measurement of its electrical conductivity is described. A pair of electrolytic cells has been designed which when used with a suitable alternating-current galvanometer will give satisfactory operation in connection with a recorder. The temperature compensation is obtained by placing both cells, which are in the two arms of a Wheatstone bridge, in a uniform temperature bath.

ETHNOBOTANY.—*The maho, or mahagua, as a trans-Pacific plant.* O. F. Cook, Bureau of Plant Industry, and Robert Carter Cook.

As noted previously in this Journal[1] the word *cumara* or *kumara*, a name for sweet potatoes, is found in the Pacific islands and among the Quichua Indians of the interior valleys of southern Peru, on the eastern slopes of the Andes. Considering the plant as a native of America, the preservation of an American name among the Polynesians appears significant. If the sweet potato and its name were carried into the Pacific in prehistoric times, other evidences of communication may be discovered.

The underlying question is whether agriculture and civilization arose independently in the two hemispheres, or had their early development in America and reached Asia by way of the Pacific islands. Did civilization grow from a single primary root, or were there parallel developments among widely separated peoples? The agriculture of ancient America undoubtedly was indigenous, since it was based on native plants. Nevertheless, several of the American plants, as the coconut palm, the sweet potato, the bottle-gourd, the yam-bean, and the upland species of cotton, appear to have been cultivated in the Pacific islands and the Malay region long before the period of discovery by Europeans. Civilization being an outgrowth of agriculture, evidence from the cultivated plants seems pertinent.

The *maho*, or *mahoe*, to use the Jamaican or West Indian name

[1] 6: 339. 1916.

Digitized by Google Original from HARVARD UNIVERSITY

that has found its way into dictionaries, is one of the economic plants that appears to have attained a trans-Pacific distribution in prehistoric times. It is a handsome woody shrub or small tree, with large lemon-yellow flowers, a member of the mallow family, a relative of the cotton plant, the okra, and the hollyhock. The leaves are entire and broadly cordate, much like those of the linden or basswood, a similarity recognized in the name given by Linnaeus, *Hibiscus tiliaceus*, or linden hibiscus. Some writers have called it lemon hibiscus and others corkwood. Many botanists have treated the maho as representing a genus distinct from Hibiscus under the name Paritium, though as originally proposed the genus was called Pariti, one of the East Indian vernacular names being adopted by Adánson as the generic designation.

A SOURCE OF FIBER AND FIRE

Among the early Polynesians the maho must have been a very important plant, since it affords two indispensable materials and has many incidental uses. The bark contains a strong, flexible fiber adapted to many purposes, tying and binding, building houses and boats, snaring or trapping game, and making bark cloths, nets, mats, baskets, and other equipment of primitive life. The wood of the maho has the peculiarity of readily producing fire by friction. The ease with which the natives of Tahiti were able to produce fire from maho wood is remarked by Darwin in the *Voyage of the Beagle*:

> A light was procured by rubbing a blunt-pointed stick in a groove made in another, as if with intention of deepening it, until by the friction the dust became ignited. A peculiarly white and very light wood (the *Hibiscus tiliaceus*) is alone used for this purpose; it is the same which serves for poles to carry any burden, and for the floating outriggers to their canoes. The fire was produced in a few seconds; but to a person who does not understand the art it requires, as I found, the greatest exertion; but at last, to my great pride, I succeeded in igniting the dust.

The heart-wood of the maho is described in Gill's *Jottings in the Pacific* as very tough and durable, fragrant, of a very dark-

Digitized by Google Original from HARVARD UNIVERSITY

green color, and well adapted for making paddles and the framework of boats and houses. Gill states that most of the firewood used in the islands is furnished by this tree, and also claims for it an important function in agriculture:

> Perhaps the greatest blessing conferred upon these islanders by this tree is its power of renewing the fertility of the soil. Nothing exhausts the soil so speedily as yams or cotton. In ten or twelve years the soil is utterly impoverished. The native plan then is to allow it to be overrun with lemon hibiscus bush. When the timber has become heavy you may be sure the soil is perfectly renewed. The soil which once was dry and hard is now light and extremely rich.

Such a possibility of reclaiming abandoned lands might prove of practical importance in many tropical countries, and would doubtless facilitate the commercial cultivation of the maho as a fiber or paper plant, which has been suggested.

A WILD PLANT IN AMERICA

As with the coconut palm and the sweet potato, the maho figures more prominently among the Polynesians than among the natives of tropical America, although the American origin of the plant is even more clearly indicated. While the coconut and the sweet potato are not known to exist in a truly wild state, the maho is an abundant or even a dominant species in many localities, all the way from Porto Rico and southern Florida to the banks of the Guayaquil River, on the Pacific coast of South America. Although used in the same ways as in the East Indies, for bark cloth and cordage, and for kindling fire, as indicated by Oviedo, Dampier, Sloane, Barrerre, and many later writers, these uses were shared with many other plants, so that no special prominence was attained by the maho. Sloane's *History of Jamaica* states that the outer layers of the bark were used for making ropes and the inner for clothing the slaves.

A CULTIVATED PLANT IN THE OLD WORLD

In the Pacific islands and in eastern Asia the status of the maho was notably different from that in America. Lack of other materials may have enhanced its importance. The making of

Digitized by Google

Original from
HARVARD UNIVERSITY

bark cloth was a much more highly developed art among the Polynesians than in America. The maho cordage was used especially for making canoes, its strength and durability not being affected by exposure to water. The plant was grown regularly from cuttings, and in some parts of the East Indies a condition of seedlessness appears to have been reached, as with other species that have been subject to vegetative propagation for long periods.

In some of the islands the maho grows spontaneously, and covers large areas that have been abandoned after previous cultivation. As a result of extensive studies of plant dispersal in the Pacific islands, Guppy classes the maho with the candle-nut as introduced trees which have replaced native forest vegetation. Low banks of tidal rivers are the favorite habitat. Though many botanists have written of the maho as a cosmopolitan seashore plant, its wide dissemination may be due largely to human agency, as with the coconut palm. The distribution in both cases extends over tropical America and the Polynesian area, including the islands and shores of the Pacific and Indian oceans.

DISTRIBUTION OF THE NAME IN AMERICA

The name maho, with many variations, is widely distributed in tropical America, and is applied locally to many other plants. The form usually employed in Spanish books is *majagua* or *mahagua*, in French *mahaut*, *mahoe*, or *mahou*. In Ecuador the maho is said to be called *jagua*. A reduplicated form, *mahou-mahou*, is listed by Martius for the Galibi Indians of Brazil, but the simple form *mahu* is also mentioned in relation to Mahu as a Tupi place name on the Upper Amazon (*Ethnographie*, 512). How far the plant extends up the Amazon is not known. No definitely recognizable equivalent has been recorded in the Quichua language of Peru, but *ahua*, meaning "string" or "thread," *ahuani* to weave, *ahuac* a weaver, and many other terms of textile implication are of possible interest for comparison with Hawaiian words of similar sound and meaning.

Digitized by Google Original from HARVARD UNIVERSITY

The chief center of popularity for *majagua* as a plant name is in the West Indies. Oviedo, who appears to have written the first account of the plant in Santo Domingo, early in the sixteenth century, called it *demmahagua* and it is still called *demajagua* and *emahagua* in Porto Rico. In de la Maza's dictionary of native Cuban plant names the word *majagua* or its diminutive *majagüilla,* appears in nearly a score of Spanish combinations, *majagua azul, majagua blanca, majagua de costa, majagua hembra,* etc., in application to several genera of *Malvaceae* and *Tiliaceae,* which have fibrous barks, including Hibiscus, Thespesia, Pavonia, Helicteres, and Guazuma. The Porto Rican name of Thespesia is *maga* or *magar*, while *maya* and *maguey* are the native West Indian names of Bromelia and Agave, two other important groups of fiber plants. Several species of Ficus, also with fibrous barks, are called *gagüey, jagüey,* or *jagüeicillo.* In Porto Rico *yagua* is the name of the leathery, fibrous leafbases of the royal palm.

The list of Mexican plant names by Ramirez and Alcocer includes *majagua* as the name of *Hibiscus tiliaceus* and *Hampea integerrima*, and also *mahahua, masahua,* and *majagüilla,* as names of the maho or of Helicteres, Heliocarpus, and Thespesia.

Maho names collected by Pittier from seven of the native languages of Costa Rica apparently have no relation to the West Indian and South American series of maho words, as may be seen from the following list: Bribri, *stsá;* Brunka, *kró-kua,* or *krók-ua;* Térraba, *kip-kuó* and *tro-kró;* Dorasque Gualaca, *kis;* Dorasque Chánguina, *i-lak;* Cuna, *Chagua tupú;* Guaymi, *kó* and *kuá-tá.* Two more aberrant names, *choucoron* and *guimauve,* are listed in Van Wijk's *Dictionary of Plant Names,* probably from Guiana.

OTHER PLANTS CALLED MAHOE IN AMERICA

Among the plants that share the name, or that have been confused locally with the *maho* elsewhere in the West Indies are *Thespesia populnea, Hibiscus clypeatus,* and *Sterculia caribaea.* In French Guiana and Brazil the names *mahoe cochon, mahaguo*

Digitized by Google Original from HARVARD UNIVERSITY

de playa and *mahaujo* are applied respectively to *Sterculia pruriens*, *Helicteres baruensis*, and *Muntingia calabura*. The last is called *majaguilla* in Venezuela, according to Ernst, who also gives *mijagua* as a name of *Anacardium rhinocarpus*. Gomez de la Maza gives *macagua* as a Cuban name of *Pseudolmedia* and *majagüin* for Pavonia. All these trees have fibrous barks that can be used for the same purposes as the maho bark. Muntingia is very widely distributed and may be considered as replacing the maho in the drier or more elevated regions of tropical America. A Quichua name for tough-barked trees is *p-hancho* or *pjancho*. Muntingia is called *ccarapjancho* in the lower Urubamba Valley, while a species of Heliocarpus is known as *llaosapjancho*.

From Colombia the names *mamagua* and *maragua* have been recorded by Pittier,[2] in relation to another fibrous-barked tree of the mulberry family, *Inophloeum armatum*. In Costa Rica and Panama, according to Pittier, the name *majagua* is not applied especially to the maho tree or its bark, but to any kind of tough bark that can be used for tying. Yet *majagüita* is given as the Costa Rican name of *Pavonia dasypetala*, a plant that furnishes a very tough fiber used by the Indians.

NAMES OF THE MAHO IN POLYNESIA

The tendency in many of the island languages is to suppress the consonants and reduce words to monosyllables, but when the simplified Polynesian names of the maho (*mao*, *mau*, *au*, *hau*, *fau*, and *vau*, are brought together, the essential unity of the series is apparent. For the tree itself the nearest approach in Polynesia to American forms of the name is *moaua*, recorded from Easter Island, or *marau*, from New Guinea, but *mahu*, *mahui*, *mahoe*, *mahaga*, *mahini*, *mahae*, *maoa*, *maharo*, *mahore*, *magoe*, *mageo*, *malo*, and many similar words, relate to the operations of peeling, spreading, pounding, or rubbing the bark, to bark cloth, or to ropes, strings, or strips of bark used in tying or snaring, or in other ways that connect naturally with the maho.

[2] Journ. Wash. Acad. Sci. 6: 114. 1916.

Digitized by Google Original from HARVARD UNIVERSITY

Although little can be inferred with confidence from single instances, the Polynesian maho vocabulary includes several rather prominent groups of words, as the examples will show. Many other words that may prove to be compounds or derivatives of maho names are to be found in the vocabularies of Tregear, Andrews, Pratt, and Churchill.

In suggesting that the Polynesian *hau* and *fau* probably came from a root meaning to "bind or tie up," Christian is in accord with a custom of philologists to deduce particular names from words of more general meaning, but primitive languages, though usually rich in specific names, may lack generic terms, which are a later development. Thus a language having many names for different kinds of spiders and different kinds of plants may still have no terms to include all spiders or all plants, so that such names as *spider-wort* or *bind-weed* are impossible. Even the Spanish could not have *bind-weed*, there being no proper equivalent of *weed*, as representing a class of plants that infest cultivated lands and interfere with the growth of crops.

The question whether *fau* refers primarily to the tree or to the act of using the bark is raised by Churchill:[3]

> In the utter absence of perspective in which these languages appear before us it would be idle to engage upon the attempt to discover whether in sense the tree or the act of using its bast is primordial. In the records before us the stem carries the tree sense without the verb in the Paumotu, the Marquesas, Nukuoro, and Aneityum; nowhere the verb where the noun does not designate a plant which yields a string.

It seems not impossible, however, that orientation in such matters may be improved by taking account of the origins, distributions, names, and uses of the agricultural and economic plants. Churchill has collected linguistic evidence of Polynesian migrations from west to east. That such migrations took place may also be inferred from the cultivation of Malayan and Asiatic plants in all of the islands, but the possession of American plants by the early Polynesian has also to be recognized and explained.

[3] Polynesian Wanderings, 328.

Digitized by Google

Original from
HARVARD UNIVERSITY

POLYNESIAN COGNATES RELATING TO FIBERS

That a root word associated with the idea of ying or binding may be very prolific in derived forms and meanings is apparent from such a series as our English band, bend, bind, bond, bound, boundary, bundle, etc. A more recently developed analogy is that of our word *wire*, now used not only as the name of fibers or cords made of metal, but also to designate the many different uses to which such material can be put, from fastening things together to sending telegrams. Corresponding series of words appear to have developed in the Pacific archipelagoes from such an original as *maho* or *mahagua*, in connection with each of the principal uses and activities connected with this tree.

In Hawaii *mahui* means to join, unite, adhere to, or imitate; *hoo-mau* is to tie on, or to fit, as sandals or shoes; *maunu*, anything that affords a hold on a person for purposes of witchcraft; *haua* and *kauhau*, to strike, to whip, chastise, or apply stripes; *auau*, a snare for catching and killing birds; *kau*, to catch, hang up, suspend; *kauo*, to drag or haul; *kaula*, a rope or strong cord, a tendon or bowstring. In Easter Island *mahetu* means twisted, like bark for rope; *mahani*, a habit, custom, or practice; and *hakamahani*, to tame, or keep tied, *haka* being a causative prefix; *hai* is to tie up; *hahai*, a package or bundle; *hahie*, firewood; *magoe* and *hahamageo*, to splice or tie together; and *hakamaga*, a roof, which primitive builders usually tie on with strips of bark. In Samoa *fau* is not only the name for the maho shrub and of string or bark used in tying, but is also the verb to tie, or to build by tying the timbers of a house together; *afauto* is the rope along the top of a fishing net; *fafau* is to lash on, to fasten with sinnet, as an adz to its handle, or an outrigger to a canoe; *faufau*, to fasten on, to tie together; *afaga*, the bandage put on the feet when climbing the coconut tree; *faufili*, a cord used by women to fasten on their burdens; and many other compounds given by Pratt.

Easter Island shares with Tonga and New Zealand such words as *mahaga*, *mehaga*, and *mahanga*, relating to nooses in ropes, snares, baits, or allurements for taking game or fish. A Samoan

Digitized by Google Original from HARVARD UNIVERSITY

name for rope is *maea*, while *maa* is a sling in Tahiti. In Paumotu *maka* is a sling, *hakamau* is to thread, join, or assure; *fakamau*, to sustain; *mau*, solid or stable; *fakahau*, to reconcile, soothe, or conciliate; *hau*, to rule, reign, or surpass, superior, kingdom, government, order, peace; *haunoho*, to stay or sojourn; *meamau*, sure, safe; *mehara*, to remember, idea, disposition, sense; *mauri*, soul or mind.

POLYNESIAN COGNATES RELATING TO BARK CLOTH

Although the paper-mulberry appears in recent times to have been more prominent than the maho as a source of bark cloth, words relating to bark cloth indicate an earlier dominance of the maho. Three distinct classes of bark-cloth words may be recognized; the first referring to the peeling and spreading of the bark, the second to the beating of the bark to separate the woody material from the fibrous network, and the third class to the finished bark cloth and its uses.

Words of the first class are represented in Hawaii by *mahihi* and *mahole*, to peel off bark from a tree, and *mahola*, to spread out, but *mahole* also means to open wide, exhibit or display, and *maholo* carries such meanings as to inspect or approve, wonder, admiration, beautiful, glorious, or admirable. In Tahiti *mahae* means to tear. *Mahore*, in the dialect of the New Zealand Maoris, means peeled, while *mahora* means to spread out. In Easter Island *maharo* means to spread out, and also to flatter, admire, or glorify. In Paumotu *mahu* is to deliver; *mahoro*, miscarriage or abortion; *pahore*, to peel off or scale; *pahure*, to be skinned; *kihoe pahurehure*, to flay; *papahoro*, to slip; *pagore*, smooth or without hair on the body; *pahere*, to lop, to prune; *pakirotu*, a piece of wood for beating off bark. In Tahiti, according to Tregear, the word *pahere* means to pare off the rind, and in Mangareva *pahore* is to pare, or the peel taken off.

Among the prominent examples of the second class of maho words, those that relate to the beating, softening, and cleaning of the bark, is *hau*, in some islands the name of the tree, in some meaning to tie or unite, in others, to reconcile or rule. But in Hawaii, Tonga, and New Zealand *hau* or *hauhau* carries the idea

Digitized by Google Original from HARVARD UNIVERSITY

of smiting, chopping, attacking, or conquering. *Wao* and *wau* are to scratch or to scrape. Of words more similar to *maho* or *mahagua*, Hawaii affords *maoha*, to rub or chafe; *mahaha*, soft and tough, also applied to a kind of fish and to a variety of taro; *maholehole*, bruised, crushed together; and *maua*, lame, sore, stiff, close or stingy. The Samoan word *maoa* means "to make a chopping or hammering sound," *vau*, *vavau*, and *valu*, to bruise, pound, scrape, grate, or rub down, as taro or arrowroot. In New Zealand, *mahoe* is a small mallet, said to be used for striking the tattooing chisel, but bark cloth was also beaten with mallets. In Paumotu *mihara* is to regret, rue, or repent; *maha*, to sooth; *mahaki* or *maehaki*, to slacken, abate, hinder, or soften; and *pahurehure*, a bruise or contusion. The Mangarevan *tahoa*, "to make papyrus by beating," is evidently connected with the Easter Islanders' *hahoa*, to cut, wound, or hurt.

The third class of bark-cloth words relates to the finished product and its uses. In Easter Island *mahututu* is "bast cloth in the last stages of composition." In Hawaii *aha*, *aho*, and *ahu* have numerous applications in connection with fibers, cords, and mats. *Ahu* in particular is a fine mat, *moena* a coarse mat, and *kapahau* "a fine species of *kapa*" made from the bark of *hau*. In Samoa *auafa* are "the fine mats constituting the wealth of a family;" *fauepa* is "to prepare the fine mats on which a dead chief is laid in state." In Paumotu *vauvau* means mat, rug, carpet, seat; *kaho* or *kao* is cloth or clothing; and *malo* a strip of bark cloth girded about the loins. *Pahorehore* in Paumotu is defined as to smooth out linen, but is similar to several words already mentioned in relation to the preparation of bark cloth.

POLYNESIAN COGNATES RELATING TO FIRE

The importance of the maho in relation to fire is reflected in the fact that the name for the tree in some of the archipelagoes, including Easter Island, is *purau*, that is, fire-*au*, while *tamau* is the word for tinder in Easter Island and Paumotu. A reduplicated form *purao-purau* is recorded from Paumotu; *pura* means phosphorescent; *purero*, to emit, issue, or appear; *purara*,

Digitized by Google Original from HARVARD UNIVERSITY

to diverge or to spread a report, as analogous to the eventual breaking out of a hidden or smouldering fire.

In Samoa *mafu* is to burn, and many Polynesian and Malay words relating to fire might be considered as echoes of the use of the maho for fire-making. *Mahao* was a Hawaiian name for pith, or for soft, rotten wood. In Wallace's list of Malayan fire-names *aow* occurs several times, and is accompanied by many similar words, *aousa, hao, ahu, afu, yafu, yap,* and *api,* the last also being widely distributed. In Tahiti *aahi* is a rag, wick, or lint for use as tinder; while in Hawaii *ahu* or *aahu* is a bag in which fire materials were carried. Kindling fire by friction is the meaning of *hogi* and *ogi* in Paumotu, and the same islands have *vera, viru,* and *viku* as another group of words relating to fire, possibly connected with *veru* a name for cloth, through the use of rags as tinder.

The two sticks of *au* wood used in bringing fire by friction have separate names in Samoa, the stick with the groove *aunaki,* that held in the hand *aulima,* the latter name being applied also to the handle of a tool of any sort. *Siaga,* another Samoan name for "a large stationary stick used in rubbing fire," is like *siapo,* the Samoan name for bark cloth, and *sia* means "to get fire by rubbing one stick on another." A fire-stick is *kounati* in Mangareva and *kauati* in New Zealand, but in Paumotu *kauati* is to make fire by friction. The use of fire in clearing land or of sticks for digging may be reflected in such words as *mahi,* which in Hawaii means to dig the ground for the purpose of planting food. In Paumotu *ahu* means to transplant, and in New Zealand to cultivate. Other uses of the wood for carrying burdens and for floating outriggers of canoes, as mentioned by Darwin in Tahiti, are reflected in such words as *auamo* and *aumaka,* names for burden-sticks in Samoa; *auala,* the bier of a dead chief; *ama,* an outrigger in Samoa, Hawaii, and Paumotu; *aumafute,* the Samoan name of the wood of the paper-mulberry after the bark is stripped off; *mafuna,* meaning to peel off, also in Samoa. The buds and young shoots of the maho were eaten in times of scarcity by the natives of some of the islands, the living tissues being mucilaginous, like those of okra.

Digitized by Google Original from HARVARD UNIVERSITY

SYNONYMS OF MAHO WORDS

That other kinds of words, unlike *maho* or *mahagua*, share their meanings in some of the islands does not make the parallel series of maho words appear less significant. Other words for bark, skin, or cloth are *kiri, kere, kero, iri*, or *ere*, which may connect also with *gere*, to strip, and *goregore*, peel or rind, in Paumotu. *Kuku* or *tutu* is a widely distributed word for beating or preparing the bark, and in Samoa *tutu* also means to kindle fire. The principal word for bark cloth is *kapa* or *tapa*, which philologists have considered an imitation of the sound of beating the bark, and *tutu* could be derived in the same way. .

In Samoa, where there are no k's, *siapo* is the principal name of bark cloth, made from the paper-mulberry, but *sema* is the name of "a red *siapo*," a color which may indicate maho-bark cloth. Bark cloth and fine mats were valuable property among the Samoans and had a collective name, *toga*, and *tolo* is another Samoan word for kindling fire by friction. Nets or cords to make them were called *kupenga* in New Zealand, *kupega* in Mangareva and Paumotu, and *hupena* in Hawaii, the last a curious approximation to the Greek *hyphaino*, to weave, and *hypha*, a thread.

The mallet for beating cloth is called *ike, eike*, or *ie*, and similar words mean to strike, defend, choose, select, or send. In addition to this *ike* the Paumotu people have *iku*, to rub, rasp, or to file; *ika*, to make fire by friction of wood; *rotika*, fire; *roroni*, to twist or wring; *rori*, to strangle with a cord; *rorirori*, pliant, flexible, or supple; *rore*, seductive or deluding. In Maori, *rore* is a snare, according to Tregear. The series may belong with the maho words, to which it runs closely parallel.

DERIVATIVE PLANT NAMES IN POLYNESIA

That the maho was an ancient possession of the island people is also to be inferred from the borrowing of its name for other plants, including three prominent cultivated species that undoubtedly were natives of Asia or the Malay region. From the manner of naming these plants it appears that the islanders

Digitized by Google Original from HARVARD UNIVERSITY

must have had previous acquaintance with the maho. In Fiji, according to Seemann, the maho is called *vaudina*, meaning the genuine *vau*, to distinguish it from several other plants called *vau*.

THE NAME OF THE PAPER-MULBERRY

One of the Polynesian namesakes of the maho is the paper-mulberry tree, called in many islands *maute* or *aute*, in Hawaii *waoke*, *wauke*, or *kawauke*, in Mangareva *eute* or *ute*. A practical reason for considering the paper-mulberry a kind of *au* (the suffix *te* meaning another kind) is that it yields bark cloth, and of a finer quality than the maho. In many of the early accounts of the islands the paper-mulberry appears more prominent than the maho, though now it is seldom cultivated and on the heavily forested islands is becoming extinct, as noted by Cheeseman in Rarotonga. It is not a strictly tropical tree, being hardy in the United States, and often escaping from cultivation. It is supposed to be a native of Japan or China rather than of the Malay region. There is a slight resemblance to the maho in habits of growth and general appearance, adult trees having simple oval or cordate leaves, but on young plants and root-sprouts the leaves are deeply notched and divided.

Other names that may belong to the paper-mulberry are *roga* in Paumotu and *roa* in Tahiti, which suggest *toga*, the Samoan name for collections of bark cloth and fine mats. These were valued as property and used as a medium of exchange. The paper-mulberry was also called *tutuga* in Samoa, and a second growth of paper-mulberry *tuapipi*. Seemann gives *ai masi* and *malo* as the native names of the paper-mulberry in Fiji, but *Ficus scabra* is also called *ai masi*, with the explanation that *masi* is derived from a verb *masia*, meaning to scour.

THE NAME OF THE ROSE OF CHINA

The Polynesians also applied the name *aute* to the "rose of China," *Hibiscus rosa sinensis*. In Rarotonga, according to Cheeseman, the maho is *au*, the paper-mulberry *aute*, and Chinese rose *kaute*. Though not at all similar to the paper-mulberry and not used for bark cloth, the rose of China is a close

Digitized by Google Original from HARVARD UNIVERSITY

relative of the maho, with the same kind of large showy flowers which render it a favorite garden shrub among the Polynesians. It was as natural that the rose of China should be called *aute* on account of its flowers as the paper-mulberry on account of its bark, but almost inconceivable that either of the two plants called *aute* should have been named directly from the other. Two Fijian names of the rose of China, *senitoa* or *seniciobia*, show no resemblance to the Polynesian names.

NAMES OF THE SCREW-PINES

Another prominent plant with a name that may have been borrowed from the maho is the Pandanus, or screw-pine, called by the Hawaiians *hala* or *halau* and by the Samoans *fala*, names that may be understood as *hau*-leaf or *fau*-leaf, and that appear proper enough when we take into account the fact that the long narrow leaves of the Pandanus are rich in fiber, and were woven or braided into mats or used in other ways like the bark of the maho or paper-mulberry. From Fiji Seemann reports *voivoi* as a native name of *Pandanus caricosus*, the species that is cultivated for the sake of its fine fiber, and *vaku vaku* for *Freycinetia milnei*, a screw-pine with edible fruit. Another name for Pandanus, possibly cognate with *maho*, is *tima*, in Paumotu, where *mau* means thread or to join. *Timau* may be analogous to *maute*, the name of the paper-mulberry in Easter Island, and is also similar to *tamau*, the word for tinder in Easter Island.

OTHER POLYNESIAN PLANTS WITH MAHO NAMES

In addition to these prominent species, maho names are applied in Polynesia to several other trees or shrubs Thus among the New Zealanders, who did not have the true maho, one of the indigenous trees (*Melicytus ramiflorus*) is called *mahoe*, and the same word is used, according to Tregear, for "a small mallet used for striking the tattooing chisel." *Mahoewai* is another New Zealand tree name, which also means "to spread out," while *mahore* means "peeled."

The Samoans give the name *faupata* to a native plant, *Cypholopus macrocephalus*, related to ramie, used for weaving fine

Digitized by Google Original from HARVARD UNIVERSITY

mats of a sort called *je sina*, second only to the kind called *je toga*, which are made from Pandanus leaves. A Samoan species of *Trama* is called *fau ui*, *fau uta* is another plant name, *fauatagaloa* is "a species of indigenous cotton," and *ma'o* is the "collective name of several trees." One tree is called *ma'oui* and another *mafoa*.

In Hawaii, *mau-a* and *ma'ua* are recorded as plant names, the former as a timber tree and the latter as food in times of scarcity, as also stated of *kemau*, which may refer to the same plant. *Mao* and *hulu hulu* are given by Watt as Hawaiian names of a native wild cotton (*Gossypium tomentosum*). Cotton and okra are called *vau vau* in Fiji, referring no doubt to the fact that these plants resemble the *vau*, this being the Fijian name of the maho. Another close relative of the maho is *Thespesia populnea*, called *mulo mulo* in Fiji, *milo* or *miro* in Samoa. It was considered a sacred tree in Tahiti, and called *toromiro*. In Mangareva *koumiro* is a name of the cotton plant. Cheeseman records a species of Grewia as *auere* in Rarotonga, where *au* is the maho. Another possible cognate is *mamaki*, recorded as the Hawaiian name of a special kind of bark cloth made from *Pipturus albidus*, a bush related to the ramie plant.

Some of the figs or banyan trees of Polynesia also furnished bark cloth and their names may be modified maho-words. In Rarotonga, according to Cheeseman, *aoa* is the name of *Ficus prolixa*, a tree planted to mark boundaries, and as the source of a coarse kind of bark cloth. In Tahiti also *aoa* refers to one of the fig trees and to bark cloth made from it. *Aoa*, *aofafine*, and *aotane* are names of the banyan and other fig trees in Samoa. *Giliau* and *kiliau* are given by Christian as names of the banyan tree in some of the Caroline Islands, where the maho is called *gili fau*. Another species, *Ficus tinctoria*, is called *mati* in Rarotonga and *matti* in Tahiti, names possibly equivalent to *maute* or *aute*, and suggestive also of names of some of the large wild fig trees in Central America, *amate* in Guatemala, and *chilamate* in Costa Rica. In Rheede's *Hortus Malabaricus* two species of figs are called *atty alu* and *ittyalu*.

Still another bark-cloth tree is *Antiaris bennetti*, called *mavu* in Fiji and *mami* in some of the other islands, according to

Digitized by Google Original from HARVARD UNIVERSITY

Seemann. Even the breadfruit tree has a fibrous bark and is sometimes used to make bark cloth. One of several names for breadfruit is *mai*, which could be considered a variant of *mau*, as *fai* replaces *fau* in some of the islands.

Maho words also appear to be used in the general sense of bush or woods, maho thickets being the only forest on some of the smaller islands. Thus in Samoa *la'au* is tree, timber, or firewood; *vao* is bush, *vai vau*, unoccupied land between two villages, and *vaomaoa*, the forest. In Hawaii *wao* is "a wild place," while *mahakea* is jungle or uncultivated land. In the Quichua language of Peru *mahiska* means abandoned and *mahini* to go wild.

MAHO NAMES OF THE WESTERN PACIFIC

In many of the Micronesian islands the names of the maho are compound words, *kili fau, kini fau, gili fau, gili fai, giri fai, gini fai*, probably meaning bark-*fau*, to distinguish from the other applications of the word. Christian states that in Ponape the maho is called *kalau*, while in another island *kalaua* means bark. In Yap the name of the maho is *kal*. In the Paumotu also *kiri* means bark or cloth, equivalent to *ere* among the Hawaiians, and to *iri*, meaning skin.

Christian gives *pa* and *pe* from two of the Caroline Islands. In Siam *po* is a name for a related fibrous-barked shrub, *Hibiscus macrophyllus*. In China *ma* is an ancient name for hemp, represented in writing by an independent radical which appears in many compound names of other plants.

It may be doubted whether names like *vahu, balibago*, and *pago*, used in Fiji, the Philippine Islands, and Guam, also belong to the *maho* series, but relation seems possible in view of intermediate Polynesian forms like *bago*, crooked, *faga*, to bend, and *haga*, to form or to build. In addition to the more prominent Tagalog name *balibágo*, Merrill's *Dictionary of the Native Plant Names of the Philippine Islands* gives *balabágo, malabago, malabayo*, and *raquíndi*, with numerous variants or compounds of *bali* and *bago* as names of other plants. Names reported from Madagascar and neighboring islands, *baro, foulsapate, var, varo, vau, vaur*, appear to connect with the Malay and Polynesian series. Van

Digitized by Google
Original from HARVARD UNIVERSITY

Wijk also gives *evonové* as a Gaboon name, the maho being reported from a few localities in West Africa. Three distinct names are recorded by Schumann and Lauterbach in German New Guinea, *daua*, *marau*, and *papalan*, and another form in the Solomon Islands, *dakatako*.

A wide-spread Asiatic name is *bellipata* or *bellipatta*, which has been reported from Singapore, Ceylon, and Bombay. Several other oriental names, *baniá*, *bariá*, *baru*, *beligobel*, *bola*, *bourao*, *chelwa*, *lo*, *surihagas*, *suringas*, *thengben*, and *thingban*, are listed in Watt's *Dictionary of the Economic Products of India*, or in Van Wijk's *Dictionary of Plant Names*. Some of these names probably were borrowed from other fiber-producing species of Hibiscus, several of which are natives of India. The name *pariti* adopted by Adanson from Rheede's *Flora Malabarica*, published in 1686, was also used in the native language to form compound names of several species of Hibiscus and Gossypium.

Many other maho names exist, no doubt, in the languages of Borneo, New Guinea, and other parts of the East Indies, as well as in Tropical America, but these are not likely to alter the general contrast between the very wide distribution of the words that connect with maho or mahagua and the very local distribution of the others.

SUMMARY

The maho, mahagua, or linden hibiscus (*Pariti tiliaceum*) is one of the economic plants to be taken into account in studying the problem of contacts between the inhabitants of tropical America and the Pacific islands, in prehistoric times. Though considered a native of America, the maho appears to have been distributed over the islands and shores of the Pacific and Indian oceans before the arrival of Europeans.

Readiness of propagation and of transportation by cuttings renders this plant well adapted for cultivation and dissemination by primitive peoples. Although human assistance in transportation does not appear to be so definitely required with the maho as with the sweet potato and other plants that are grown from only cuttings, the names of the maho afford almost as

Digitized by Google Original from HARVARD UNIVERSITY

definite indications of human contacts as in the case of *kumara*, a name for sweet potato already known to have been shared by the Pacific Islanders with the Indians of Peru.

The name *maho* or *mahagua*, with numerous local variants, is widely distributed in tropical America and is closely approximated in many of the Pacific islands, in relation either to the plant itself or to its principal uses for fiber, bark cloth, and fire-making. While the genetic relationships of particular words or applications are to be considered as possible rather than as proved, the general coherence of names and uses would seem to justify a thorough philological investigation. One gains an impression of the language being formed *in situ*, as a reflection of familiar objects and activities in the minds of the islanders.

That the primitive Polynesians were in possession of the maho before they became acquainted with similar Asiatic plants may be inferred, in view of the indications that Polynesian names of other important cultivated plants—the paper-mulberry (Papyrius or Broussonetia), the rose of China (*Hibiscus rosa sinensis*), and the screw-pine (Pandanus)—were derived from names of the maho. The making of fire by friction of wood and of cloth by beating the bark of trees with grooved mallets are specialized arts which may have been carried with the maho from America across the tropical regions of the Old World. A plant that enabled primitive man to kindle fire and tie things together must be held to have contributed much to the arts of civilization.

Digitized by Google Original from HARVARD UNIVERSITY

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this JOURNAL and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

GEOLOGY.—*Mining developments and water-power investigations in southeastern Alaska.* THEODORE CHAPIN, H. M. EAKIN and G. H. CANFIELD. U. S. Geological Survey Bulletin 662-B. Pp. 92, with maps, sections, and illustrations. 1917.

Contains short papers on the work of 1916, as follows: *Mining developments in the Ketchikan and Wrangell mining districts*, by THEODORE CHAPIN; *Lode mining in the Juneau gold belt*, by H. M. EAKIN; *Gold placer mining in the Porcupine district*, by H. M. EAKIN; *Water-power investigations in Southeastern Alaska*, by G. H. CANFIELD.

R. W. STONE.

GEOLOGY.—*Mineral springs of Alaska.* GERALD A. WARING, with a chapter on the *Quality of some surface waters*, by RICHARD B. DOLE and ALFRED A. CHAMBERS. U. S. Geological Survey Water-Supply Paper 418. Pp. 109, with 9 plates and 16 figures. 1917.

The report contains a preliminary chapter on the physiography and geology of Alaska by ALFRED H. BROOKS. The mineral springs are grouped for description into hot, carbonated, sulphur, iron, and salt springs, and individual mention is made of most of the 110 springs whose locations are shown on maps accompanying the report. Analyses of a number of the waters are given, and their characters are described briefly in relation to the rock formations through which they issue.

A number of the stream waters of the Territory were also analysed, and their characters are discussed in a separate chapter, by RICHARD B. DOLE and ALFRED A. CHAMBERS. G. A. W.

Digitized by Google Original from HARVARD UNIVERSITY

GEOLOGY.—*The Helderberg limestone of central Pennsylvania.* JOHN B. REESIDE, JR. U.S. Geological Survey Professional Paper 108-K. Pp. 41. 1917.

A study of seven localities in Pennsylvania leads to the following conclusions:

1. The Tonoloway limestone and the Keyser, Coeymans, and New Scotland members of the Helderberg limestone may be traced from Maryland through central Pennsylvania with their respective characteristic lithology and faunas, and the essential equivalents of all are to be found in New Jersey and eastern New York.

2. The Keyser member decreases in thickness northward from Maryland.

3. The Devonian elements in the fauna apparently decrease from Maryland to New Jersey and New York.

4. The suggestion of an unconformity at the top of the Keyser in Maryland is borne out in Pennsylvania by the variations in thickness of the member and the presence of arenaceous material at the base of the Coeymans. R. W. STONE.

GEOLOGY.—*Geologic structure in the Cushing oil and gas field, Oklahoma, and its relation to the oil, gas, and water.* CARL H. BEAL. U. S. Geological Survey Bulletin 658. Pp. 64, with maps, sections, and illustrations. 1917.

The geologic work done in the field has disclosed the following principal facts:

1. The folding of the formations in the Cushing field usually becomes greater with increase of depth, and there are many marked differences in structure among the Layton, Wheeler, and Bartlesville sands and the surface beds.

2. The interval between the Layton and Bartlesville sands is generally greater around the edges of the anticlines than on their crests.

3. The distribution of the bodies of oil, gas, and water indicates that the source of the oil lay west of the Cushing field.

4. In general the oil area in an elongated dome, where folding is simple, extends farther down on the long axes of the anticline or dome than on the steeper sides.

5. The water surfaces on which the oil and gas rest in the different sands are not level but are inclined away from the centers of the anticlinal folds. R. W. STONE.

Digitized by Google Original from HARVARD UNIVERSITY

GEOLOGY.—*The Palestine salt dome, Anderson County, Texas; The Brenham salt dome, Washington and Austin counties, Texas.* OLIVER B. HOPKINS. U. S. Geological Survey Bulletin 661-G. Pp. 28, with maps, sections, and illustration. 1917.

Viewed as a whole the Palestine dome is a quaquaversal fold on whose flanks are highly inclined beds that dip in all directions away from its center but become approximately horizontal within a few miles; the center of the uplift is extensively faulted, mainly in a northeasterly direction, producing an irregular distribution of the Cretaceous beds and a triplication of the outcrop of the Austin chalk.

Such an intensive and highly localized vertical uplift of quaquaversal form could be produced only by vertical thrust from below. The results observed are analogous to those produced by driving a punch into a sheet of cold steel: the effects are entirely local.

The peculiar local nature of salt domes may be due to the effect of dynamic activity at certain points along lines of deformation, aiding in the solution and transportation of salt, gypsum, etc., from deep-lying formations, probably Permian, to the position in which they are found.

The highly folded, faulted, and eroded condition of the Palestine dome and the general absence of oil and gas as surface seepages and in shallow wells in this area detract from its oil prospects.

The results of drilling for oil in the Brenham dome have been discouraging, except that they have demonstrated the presence of a salt dome. Suggestions are given regarding further drilling at this dome.

R. W. STONE.

GEOLOGY.—*Oil and gas possibilities of the Hatchetigbee anticline, Alabama.* OLIVER B. HOPKINS. U. S. Geological Survey Bulletin 661-H. Pp. 33, with maps, sections, and illustrations. 1917.

The geological examination of the area shows that a broad, low anticline, the Hatchetigbee anticline, extends from a point north of Jackson, Ala., northwestward across Tombigbee River to the Alabama-Mississippi state line and beyond; that the disturbance of the earth's crust which produced this fold also produced a fault, the Jackson fault; that the Hatchetigbee anticline has in general stronger dips on its southwestern slope than on its northeastern; that two areas along the crest of the fold are particularly favorable, structurally, for the accumulation of oil and gas, and other areas along the crest of the

Digitized by Google Original from HARVARD UNIVERSITY

fold and along the east side of the Jackson fault are also favorable; that the best chances for accumulations of oil are probably in the sands above and below the Selma chalk, which lies from 780 to 2700 feet below the surface along the crest of the anticline; and finally that there are doubtless other areas of favorable structure in the adjoining region where oil and gas may have accumulated if they are present in commercial quantities anywhere in the region.

R. W. Stone

ORNITHOLOGY.—*Washington region [April and May, 1917].* Harry C. Oberholser. Bird-Lore **19**: 211–212. 1917.

The months of April and May, 1917, were unusually cold at Washington, D. C., and the resultant spring migration of birds was peculiar. Many species of migrants that appeared in April were ahead of their usual schedule, but many that came in May were very much delayed. A number of birds rare in the District of Columbia, at least during spring, made their appearance, chiefly in May. Conspicuous among these were *Phalacrocorax auritus auritus*, *Larus atricilla*, *Chlidonias nigra surinamensis*, *Hydroprogne caspia*, *Phloeotomus pileatus abieticola*, *Pisobia fuscicollis*, and *Protonotaria citrea*. H. C. O.

ORNITHOLOGY.—*Description of a new subspecies of* Perisoreus obscurus. Harry C. Oberholser. Proc. Biol. Soc. Washington **30**: 185–188. December 1, 1917.

A new geographic race of the Oregon jay is here described as *Perisoreus obscurus rathbuni*, from Clallam County, Washington. It is darker than either *Perisoreus obscurus obscurus* or *Perisoreus obscurus griseus*, and much more grayish above than the former, with a usually broader whitish nuchal collar. Its geographic distribution is apparently limited to that part of the State of Washington about Puget Sound and the Strait of Juan de Fuca. H. C. O.

ORNITHOLOGY.—*A review of the subspecies of the Leach Petrel* (Oceanodroma leucorhoa (*Vieillot*). Harry C. Oberholser. Proc. U. S. Nat. Mus. **54**: 165–172. October 19, 1917.

Notwithstanding the considerable attention that has been paid to the petrels of the *Oceanodroma leucorhoa* group, there is evidently something yet to learn concerning these birds. A study of the entire species, with extensive material, leads to the conclusion that three forms are recognizable: *Oceanodroma leucorhoa leucorhoa* (Vieillot),

Digitized by Google Original from HARVARD UNIVERSITY

which breeds in the North Atlantic and North Pacific Ocean; *Oceanodroma leucorhoa beali* Emerson, which breeds from southeastern Alaska to the coast of northern California; and *Oceanodroma leucorhoa kaedingi* Anthony, which occurs off the Pacific coast of Lower California, south to the Revillagigedo Islands, western Mexico. Of these three forms only the first and third are currently considered valid. Furthermore, *Oceanodroma leucorhoa kaedingi* has hitherto been treated as a species, whereas it is but a subspecies of *Oceanodroma leucorhoa*. H. C. O.

ORNITHOLOGY.—*A new subspecies of* Geothlypis beldingi. HARRY C. OBERHOLSER. The Condor **19**: 182–184. December 7, 1917.

A very distinct subspecies of the Belding yellow-throat is here described as *Geothlypis beldingi goldmani*, from San Ignacio, Lower California. It differs from *Geothlypis beldingi beldingi* in its much duller and less yellowish upper parts, whitish instead of yellowish area on the crown behind the black mask, and more restricted yellow of lower surface. Its breeding range is confined to central Lower California, although a single specimen indicates its wintering in the Cape San Lucas region. H. C. O.

ORNITHOLOGY.—*A remarkable martin roost in the city of Washington.* HARRY C. OBERHOLSER. Bird-Lore **19**: 315–317. December 1, 1917.

Although late summer roosts of the purple martin are by no means uncommon in the eastern United States, there is apparently no record of a martin roost in the District of Columbia prior to 1917. During the latter part of the summer of this year great numbers of the purple martin (*Progne subis subis*) gathered nightly in the Mall, along Fourth Street, where they roosted in the trees along the street-car line. The birds were first noted here on August 5 and continued nightly to resort to this roost until September 9. The number of birds ranged from about 2500 to about 12,000, but the usual number was between 7000 and 8000. They assembled daily about 25 or 30 minutes before sunset and were all at rest in the trees by from 12 to 30 minutes after sunset. Their evolutions during this period were of much interest. During the martin occupation this roost regularly housed also between 100 and 500 European starlings (*Sturnus vulgaris vulgaris*), from 1000 to 4000 purple grackles (*Quiscalus quiscula quiscula*); also, on a few days, a number of bank swallows (*Riparia riparia riparia*) and rough-winged swallows (*Stelgidopteryx serripennis serripennis*). H. C. O.

Digitized by Google Original from HARVARD UNIVERSITY

ORNITHOLOGY.—*Notes on North American birds. III.* Harry C. Oberholser. The Auk **34**: 465–470. October, 1917.

This paper contains technical notes on two genera and three species. The genus *Bannermania* Mathews and Iredale, recently proposed for the reception of *Oceanodroma hornbyi* (Gray), proves on examination of further material to be invalid, since the characters given in the original diagnosis are not constant. The name of the species should therefore remain *Oceanodroma hornbyi*.

The subgenus *Cymochorea* Coues, recently raised to generic rank by Mathews and Iredale, seems not to be worthy of this elevation. A careful examination of the species of *Oceanodroma* discloses the fact that there are no constant structural differences between them, and that consequently all must be included in the same genus. In view of this, *Cymochorea* Coues can be considered of nothing more than subgeneric rank.

A new subspecies of booby (*Sula dactylatra californica*), recently described by Dr. Walter Rothschild from San Benedicto Island, in the Revillagigedo group, western Mexico, although said to be from California, has apparently never been taken within the confines of that State, and therefore must be excluded from the list of North American birds.

The name *Fregata aquila* Linnaeus, currently applied to the North American frigate bird, has been shown by Mathews to be applicable only to the bird of Ascension Island in the South Atlantic Ocean. The frigate birds of North America now prove to belong to two other species: that of the West Indies and southeastern United States being *Fregata magnificens rothschildi* Mathews, and the Pacific bird, *Fregata minor palmerstoni* (Gmelin).

The name *Strix wapacuthu* Gmelin, recently revived for the Arctic horned owl (the *Bubo arcticus* of Swainson), is now shown, as contended previously by Mr. Brewster, to be applicable only to *Nyctea nyctea*, and thus unavailable for the other species, which should therefore still be called *Bubo virginianus subarcticus* Hoy. H. C. O.

Digitized by Google Original from HARVARD UNIVERSITY

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

WASHINGTON ACADEMY OF SCIENCES

The meeting of the Board of Managers on February 18, 1918, was devoted chiefly to the discussion and amendment of the report of a special committee on membership policy. The Board adopted rules for the guidance of the Committee on Membership, limiting the resident membership of the ACADEMY to 20 per cent of the active scientific population of Washington, as represented by the number of names in the "Red Book" (the biennial directory of the ACADEMY and its affiliated societies). The requirements for admission to membership, which are stated only in general terms in the By-Laws of the ACADEMY, were more exactly defined by the Board; the principal qualifications adopted is that "the nominee shall have attained recognition for original and meritorious scientific investigation."

ROBERT B. SOSMAN, *Corresponding Secretary.*

BIOLOGICAL SOCIETY OF WASHINGTON

The 578th regular meeting of the Society was held in the Assembly Hall of the Cosmos Club, Saturday, January 26, 1918; called to order at 8 p.m. by President ROSE; 62 persons present.

On recommendation of the Council, J. B. NORTON and S. F. BLAKE, both of the Department of Agriculture, were elected to membership.

On recommendation of the Council a proposed amendment to the constitution was announced by which members of the Society might become life members upon the payment of fifty dollars in two annual installments of twenty-five dollars each.

Under the heading brief notes and exhibition of specimens the following informal communications were presented:

A. WETMORE remarked on food habits of grackle with reference to eating and cracking pin-oak acorns, the peculiar structure of the bill of the genus *Quisqualus* being specially adapted for this purpose. This was discussed by Messrs. PAUL BARTSCH, VERNON BAILEY, and F. V. COVILLE.

A. S. HITCHCOCK called attention to a recently issued flora of the Rocky Mountains by P. A. Rydberg, in which 6000 species of plants of that region are described.

PAUL BARTSCH referred to a recently received collection of Philippine shells from the island of Luzon, containing an unusually large number of new forms.

L. O. HOWARD referred to the utilization of acorns for the manufacture of alcohol.

Digitized by Google Original from HARVARD UNIVERSITY

W. L. McAtee described the behavior of ducks, geese, bitterns, jacksnipe, and kingfishers in North Carolina during the recent continued cold weather; the kingfishers' activities being confined to the vicinity of spring holes.

The regular program of the evening was as follows:

Emerson Stringham: *Notes on the speed of fishes, especially the alewife.* Mr. Stringham said the question of the speed with which fish swim has elements which, it would seem, might make it popular, but there appear to be few recorded observations. It becomes of economic importance in connection with the effect of water power development on the fisheries.

Three preliminary points should be mentioned. In the first place some fish, besides swimming, are able to jump from the water and by this means pass over a current which it would be wholly impossible for them to swim through; we are not concerned here with that question. Secondly, it is assumed that if a fish can maintain itself against a steady current of so many miles an hour, it can swim the same number of miles an hour in still water. Thirdly the velocity of a stream is much less at the bottom or behind obstacles than at surface.

A Belgian engineer (G. Denil), while studying fishways, concluded that the salmon could swim at a speed of 3.15 meters a second for at least 14 meters. The author also refers to similar figures given by a French engineer. In a report on the obstructed condition of the Frazer River published in the Report of the British Columbia Commissioner of Fisheries for 1913, the author (G. P. Napier) expresses the opinion that the limiting velocity of a steady stream up which a sockeye salmon is apparently capable of swimming a very short distance lies between six and seven miles an hour. Mr. H. von Bayer, of the Bureau of Fisheries, published a paper on fishways in 1910, in which he said that the current velocity in fishways should not exceed 10 feet per second. It is remarkable that the three figures, which appear to be independent of each other, are almost identical. The Belgian estimate is about 6.9 miles an hour, the Canadian's is 6 to 7 miles an hour and the American's is 6.8 miles an hour.

In the spring of 1917 Mr. Stringham had an opportunity to study several fishways in Massachusetts, and to make some observations on the velocities of water up which the fish swam. These fish belonged to the species *Pomolobus pseudoharendus* (Wilson), one of the common alewives. The instrument used to measure the velocity of the water was a Price current meter lent by the Bureau of Standards. Measurements were made of the rate of flow at 7 points in the fishway where the current appeared to be greatest, and it was found to vary from 4 to 5 feet per second. At Middleboro the fish were unable to ascend a little sloping falls where the velocity was about 11 feet per second. Just below they were swimming through one place where the current was 5.3 feet per second. At East Warham the head of water, and therefore the velocity could be varied. The fish swam up a slope about 3

Digitized by Google Original from HARVARD UNIVERSITY

feet long where the water was going down at rates of 6.1, 7.8, and even 9.8 feet per second. They were perfectly helpless when it was raised to 13.5 feet per second.

These figures show that for a few feet at least this species can swim through water flowing about 10 feet per second. That is the same figure suggested for the salmon by two different investigators and is the limit suggested for fishways by a third.

The paper was discussed by WILLIAM PALMER, A. N. CAUDELL, VERNON BAILEY, PAUL BARTSCH, H. M. SMITH, E. A. GOLDMAN, and R. W. SHUFELDT.

W. E. SAFFORD: *Natural history of Paradise Key, Florida.*

Mr. Safford's paper was illustrated by numerous lantern slides and is to be published in the Annual Report of the Smithsonian Institution.

M. W. LYON, JR., *Recording Secretary.*

ENTOMOLOGICAL SOCIETY OF WASHINGTON

The 309th regular meeting of the Society was held at the Saengerbund Hall, January 4, 1918; called to order by President SASSCER; 26 members and 10 visitors were present.

A resolution was adopted providing for a permanent entertainment fund to be administered by an Entertainment Committee appointed by the Executive Committee.

Articles III (Members) and VII (Fees) of the Constitution were amended.

The regular program consisted of the address of the retiring President, Prof. C. R. ELY, upon *Recent entomological chemistry.* This interesting review of literature called forth considerable discussion, participated in by Messrs. MIDDLETON, SASSCER, G. G. AINSLIE, WOGLUM, BAKER, WOOD, and BISHOP.

At the close of this discussion the Society was entertained by some brief remarks from two of our visitors, Prof. A. L. LOVETT, of the Oregon Agricultural College, and Mr. R. H. ALLEN, of Massachusetts.

Mr. PAINE exhibited some interesting photographs made under artificial light.

The 310th meeting of the Society was held at the Cosmos Club, February 7, 1918; called to order by the PRESIDENT; 29 members and 9 visitors were present.

The annual report of corresponding-secretary-treasurer was accepted. The corresponding secretary announced the following changes in the publication of the Proceedings: The Proceedings will appear in nine numbers per year instead of four, and will carry advertising. The cover will be printed on the same kind of paper as the text, the seal omitted, and in the space now occupied by the seal will appear the table of contents. Each page will carry a running head which will constitute a complete citation, and the printing of the list of members present at meetings as well as all business transacted at the meetings will

Digitized by Google Original from HARVARD UNIVERSITY

be discontinued. Other minor changes looking to the improvement of the publication will also be made.

Dr. Carlos E. Porter, of Santiago, Chile, and Mr. Robert M. Fouts, of Washington, D. C., were elected to membership.

The regular program was as follows:

C. L. Marlatt: *Notes on the work of the Federal Horticultural Board.* Mr. Marlatt gave a very comprehensive account of the organization, purposes, and scope of the services of the Board.

In discussing Mr. Marlatt's remarks, Dr. L. O. Howard gave a very interesting account of the events and causes which led to the passage of the Plant Quarantine Act.

Carl Heinrick: *On the Lepidopterous Genus Apostega and its larval affinities.* The author illustrated his remarks with a number of charts and drawings. This communication drew forth considerable discussion, participated in by Messrs. McIndoo, Pierce, Rohwer, Baker, Boving, Craighead, and Hyslop.

Under the head of short notes:

Dr. Howard announced the recent death of an early member of the Society, Mr. Chas. R. Dodge. Mr. Schwarz also gave a few reminiscences of Mr. Dodge.

Mr. Snyder called attention to a recent article entitled *Origin of castes in termites* by Dr. C. B. Thompson, of Wellesley College, published in the *Journal of Morphology.* Mr. Snyder spoke very highly of the paper, as did also Messrs. Baker and Howard.

Mr. Snodgrass expressed his pleasure at the evident interest manifested and progress being made in the study of insect anatomy. Messrs. Howard, Caudell, and Craighead gave additional remarks along the same line.

Dr. T. J. Headley, of New Jersey, responded to the president's invitation to address the Society by giving some interesting reminiscences from his experiences.

Mr. J. G. Sanders, of Harrisburg, Pennsylvania, responding to a similar invitation, gave an interesting account of some of his experiences since leaving the Bureau of Entomology to go to Wisconsin and later to Pennsylvania. He gave an especially interesting account of some recent researches in Pennsylvania on the life history of the Angoumois grain moth.

A. B. Gahan, *Recording Secretary.*

PHILOSOPHICAL SOCIETY OF WASHINGTON

The 799th meeting was held at the Cosmos Club, January 19, 1918, with President Burgess in the chair. There were 45 persons present.

Mr. E. T. Wherry presented a paper on *Certain relations between optical properties and crystal form, and their bearing on the question of "crystal molecules" in organic compounds.* The refractive indices of several simple organic compounds have been determined by the immersion method, and their values substituted in the Lorentz formula

Digitized by Google Original from HARVARD UNIVERSITY

connecting refractive index and density. The "refraction ratio," or ratio of the several values obtained for each substance, has been compared with the crystallographic axial ratio in each case. In some substances, as urea and iodoform, the two sets of values show exact inverse proportionality, and it is concluded that this indicates that the number of pinacoidal planes in the two crystallographic directions in the crystal molecule, or unit cell of the space lattice, is the same. Others, like oxalic acid, show inverse proportionality in two directions but not in the third, although in the latter a simple integral relation exists. It is concluded that in these the crystal molecule contains different numbers of planes in some directions than in others. In acetamide, which is dimorphous, the planes show somewhat greater divergence in the unstable than in the stable form, suggesting that there is a tendency toward equalization of the number of planes. From these data it is possible to draw conclusions as to the types of space-lattices represented in these substances, without the necessity of submitting them to examination by X-rays.

Discussion: The paper was discussed by Messrs. MERWIN, WHITE, SOSMAN, and BICHOWSKI.

A paper by W. F. MEGGERS and C. G. PETERS on *The refractive index and optical dispersion of air,* was presented by Mr. PETERS. This paper was illustrated by lantern slides. A survey of previous researches on refraction of air shows that most investigators have worked either with white light or with one monochromatic radiation, and dispersion measurements have been limited to a small interval of the spectrum. No index measurements exist for waves longer than those corresponding to orange light, and in the ultra-violet the dispersion formulas disagree by more than 10 per cent of the index of refraction.

Recent work in spectroscopy makes it very desirable to have more accurate and extensive data on the index of refraction and dispersion of air. The international system of standard wave length measurements made under other conditions require small corrections because of the effect of temperature and pressure of the air upon its optical dispersion. Furthermore, it is often desirable to multiply wave lengths measured in air by the indices of refraction of air for these wave lengths and thus convert them to their value in vacuum. An accuracy of one part in several millions is now striven for in the measurement of wave lengths, and to maintain their relative accuracy in the reduction to vacuum values it is necessary to know the indices of refraction to about one unit in the seventh decimal place.

For several years the Bureau of Standards has been engaged in the accurate measurement of wave lengths. Interferometer comparison of wave lengths have been made throughout a large range of spectra and the grating spectra of more than fifty of the chemical elements have been photographed and measured in the red and infra-red spectral regions. In connection with these accurate measurements of wave lengths, it was thought advisable to measure the absolute indices of refraction of air for the entire spectra region that is accessible to photography.

Digitized by Google Original from HARVARD UNIVERSITY

Accuracy and efficiency recommended the use of a interferometer of the Fabry and Perot type for this work, since this apparatus can be conveniently enclosed in a chamber in which the temperature and pressure of the air can be regulated as desired, and it also permits simultaneous observations for a large number of different wave lengths. Sections of the circular fringes, produced by various radiations from a source of light illuminating the parallel plates of the interferometer, were photographed either with a grating or a prism spectrograph, first when the space between the plates was evacuated and then when dry air at measured temperature and pressure was present.

The index of refraction of air for a particular wave length was obtained directly from measurements of the photographed interference fringes, which allowed the ratio of lengths of this wave in vacuum and in air to be calculated. Observations were made at spectrum intervals of about 40 *A* from the extreme ultra-violet at 2200 *A*, through the visible spectrum and into the infra-red to 9000 *A*.

Complete sets of observations were made on dry air at atmospheric pressure and at temperatures of 0°C., 15°C., and 30°C. These are quite well represented by the following dispersion formulae:

$$(n-1)_0 \times 10^7 = 2875.66 + \frac{13.412}{\lambda^2 \times 10^8} + \frac{0.3777}{\lambda^4 \times 10^{16}}$$

$$(n-1)_{15} \times 10^7 = 2726.43 + \frac{12.288}{\lambda^2 \times 10^8} + \frac{0.3555}{\lambda^4 \times 10^{16}}$$

$$(n-1)_{30} \times 10^7 = 2589.72 + \frac{12.259}{\lambda^2 \times 10^8} + \frac{0.2576}{\lambda^4 \times 10^{16}}$$

The coefficient of index variation with temperature was found from these observations to be a function of the wave length. For long waves this optical temperature coefficient is identical with the density temperature coefficient, i.e., $\frac{1}{273}$, but as the ultra-violet absorption band is approached it increases rapidly, becoming $\frac{1}{258}$ at 2500 *A*.

Discussion: This paper was discussed by Messrs. BURGESS, SWANN, CRITTENDEN, and MEGGERS.

The third paper, on *Barometric ripples*, was presented by W. J. HUMPHREYS. This paper was illustrated by lantern slides. Small pressure changes, amplitude usually 0.1 to 0.3 mm. and period of 5 to 10 minutes, and continuing for hours or even days together, are very common during cold weather.

As first demonstrated by Helmholtz, whenever layers of air that differ in density at their interface flow over each other, long billows, analogous to gravity water waves, are produced, which conform, approximately, to the equation

Digitized by Google Original from HARVARD UNIVERSITY

$$d_1 (u - V)^2 + d_2 (V - v)^2 = \frac{g \lambda (d_2 - d_1)}{2\pi}$$

in which V is the velocity of wave propagation, d_1 and d_2 the densities of the layers whose velocities are u and v respectively, g the gravity acceleration, and λ the wave length. If, now, the under layer is colder than the upper, as often happens during winter, and rather shallow, 100 meters to 500 meters thick, say, the passage of the air billows, like the passage of waves in shallow water, necessarily produces greater or less corresponding changes in the pressure on the bottom layer—changes that appear as a series of ripples in the record of a sensitive barograph. Furthermore, such shallow air billows, like shallow water waves, doubtless are turbulent—a condition that accounts, presumably, for the surprisingly rough flying the aviator often experiences during winter at low levels (300 meters and less).

During summer when air billows rarely form near the surface, though frequently at greater altitudes, especially that of the cirrus cloud, barometric ripples and shallow turbulences of the kind just mentioned seldom occur. This, doubtless, is because wave disturbances in air as in water do not penetrate far beneath the wave level.

Discussion: Mr. LITTLEHALES called attention to the fact that where there are two layers of water of different density, waves frequently occur at the interface that separates the two water layers and yet no waves are visible on the surface. These waves at times are sufficient to impede the progress of vessels. The paper was further discussed by Messrs. WHITE, BURGESS, SWEET, BUCKINGHAM, and SOSMAN.

H. L. CURTIS, *Recording Secretary.*

Digitized by Google

Original from
HARVARD UNIVERSITY

SCIENTIFIC NOTES AND NEWS

The Honorary Advisory Council for Scientific and Industrial Research of Canada visited Washington on February 25–28. The Council is considering plans for the encouragement of scientific research in Canada, and spent some days in consultation with members of the National Research Council, and in visiting the scientific bureaus of the Government. The visiting members were: Professor A. B. Macallum, of the University of Toronto, (chairman); Professor S. F. Kirkpatrick, of Queen's University, Kingston; Professor R. F. Ruttan and Professor F. D. Adams, of McGill University, Montreal; President A. S. Mackenzie, of Dalhousie University, Halifax; Mr. Arthur Surveyer, of Montreal; Mr. J. B. Challies, of the Water Power Branch, Department of the Interior, Ottawa, (Honorary Secretary of the Council).

Professor C. A. Kofoid, of the Department of Zoology, University of California, has been commissioned a major in the Sanitary Corps of the National Army, and is stationed at the Department Laboratory, Fort Sam Houston, San Antonio, Texas.

Major R. A. Millikan, member of the National Research Council and Chief of the Science and Research Division of the Signal Corps, has been commissioned a Lieutenant Colonel in the Signal Corps.

In honor of the appointment of Dr. J. W. Fewkes as Chief of the Bureau of American Ethnology, a complimentary luncheon was tendered to him and Mrs. Fewkes at the Smithsonian Institution on Friday, March 1, 1918. Every member of the staff and all the employees of the Bureau were present. At the close of the luncheon Dr. Fewkes made a brief address, recalling the high traditions of the Bureau of Ethnology and outlining plans for its further development. The primary objects of ethnologic research in this country were defined by Dr. Fewkes as, *Man in America,—where did he come from, how long has he been here, and what has he been doing since he came?* Short speeches were made by members of the Bureau, the first speaker being Mr. James Mooney, who noted that the study of ethnology tends to bind the whole human race together by securing a better understanding of mankind.

The following persons have become members of the Academy since the last issue of the Journal: Mr. Lon A. Hawkins, Bureau of Plant Industry, Department of Agriculture, Washington, D. C.; Dr. Oscar Riddle, Department of Experimental Evolution of the Carnegie Institution of Washington, Cold Spring Harbor, Long Island, New York; Mr. Erskine Douglas Williamson, Geophysical Laboratory of the Carnegie Institution of Washington, Washington, D. C.

Digitized by Google

Original from
HARVARD UNIVERSITY

ANNOUNCEMENT OF MEETINGS OF THE ACADEMY AND AFFILIATED SOCIETIES[1]

Tuesday, March 26: The Anthropological Society, at the West Study Room of the Public Library, at 8 p.m. Program:

Dr. V. Giuffrida-Ruggeri, Professor of Anthropology at the University of Naples. The paper will be read by Dr. Austin H. Clark, U. S. National Museum: *The origins of the Italian people.*

Thursday, March 28: Society of American Foresters. Program:

Raphael Zon: *The forest resources and timber trade of the world after the war.*

Thursday, March 28: The Washington Academy of Sciences, at the Cosmos Club. Program to be announced later.

Saturday, March 30: The Philosophical Society, at the Cosmos Club, at 8:15 p.m. Program:

D. L. Hazard, of the U. S. Coast and Geodetic Survey: *The magnetic survey of the United States.*

J. P. Ault, of the Department of Terrestrial Magnetism, Carnegie Institution: *Cruises III and IV of the Yacht* Carnegie *in the Arctic and Sub-Antarctic Regions, 1914-1917.*

(Illustrated with slides and moving pictures.)

Tuesday, April 2: The Botanical Society, at the Cosmos Club, at 8 p.m.

Thursday, April 4: The Entomological Society.

[1] The programs of the meetings of the affiliated Societies will appear on this page if sent to the editors by the thirteenth and twenty-seventh day of each month.

Digitized by Google

Original from
HARVARD UNIVERSITY

CONTENTS

Original Papers

Page

Oceanography.—An electrical instrument for recording sea-water salinity. Ernest E. Weibel and Albert L. Thuras 145

Ethnobotany.—The maho, or mahagua, as a trans-Pacific plant. O. F. Cook and Robert Carter Cook 153

Abstracts

Geology 171

Ornithology 174

Proceedings

Washington Academy of Sciences 177

Biological Society 177

Entomological Society 179

Philosophical Society 180

Scientific Notes and News 184

Digitized by Google

Original from HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google
Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY

TOZZER LIBRARY
3 2044 041 827 270

Digitized by Google

Original from
HARVARD UNIVERSITY

Digitized by Google

Original from
HARVARD UNIVERSITY